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THE ASSESSMENT AND ETIOLOGY OF NOVELTY SEEKING AND RULE-BREAKING
IN YOUNG CHILDREN

by

Emma Diaz

B.A., University of Nevada, Las Vegas, 2013

A Thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Arts Degree

Department of Psychology
in the Graduate School
Southern Illinois University Carbondale
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THESIS APPROVAL

THE ASSESSMENT AND ETIOLOGY OF NOVELTY SEEKING AND RULE-
BREAKING IN YOUNG CHILDREN

By

Emma B. Diaz

A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of
Master of Arts
in the field of Psychology

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June 16, 2017

AN ABSTRACT OF THE THESIS OF

Emma Diaz, for the Master of Arts degree in Psychology, presented on June 16, 2017, at Southern Illinois University Carbondale.

TITLE: THE ASSESSMENT AND ETIOLOGY OF NOVELTY SEEKING AND RULE-BREAKING IN YOUNG CHILDREN

MAJOR PROFESSOR: Dr. Lisabeth DiLalla

This study explored the stability and heritability of novelty seeking, defiance, and rule-breaking in early childhood using a twin sample. Parent reports of novelty seeking were assessed at ages 3 and 4, parent reports of rule-breaking were assessed at ages 5 and follow-up (6-16), and observer reports of defiance were assessed at age 5. Results showed that novelty seeking increased between ages 3 and 4, and rule-breaking remained stable from age 5 to follow-up (6-16). All constructs demonstrated significant heritability. Finally, neither novelty seeking nor defiance predicted 5-year-old rule-breaking. Defiance was the only construct that significantly predicted follow-up rule-breaking. Defiance and rule-breaking in early childhood were predictive of later rule-breaking, indicating that children may benefit from early intervention to reduce later rule-breaking behaviors.

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CHAPTER 1

INTRODUCTION

Novelty seeking and rule-breaking are problem behaviors commonly studied in adolescence. Novelty seeking refers to an individual's desire to engage in high intensity activities due to personal enjoyment (Hink et al., 2013). Non-aggressive rule-breaking is considered to be a form of antisocial behavior that lacks an aggressive component (Burt, 2012a). Conceptually, an individual's desire to engage in risky activity may predispose them to engage in rule-breaking behavior due to its novel and intense nature (e.g., stealing, lying). This behavior can include anything from defiance to lying, theft, and more traditional delinquent behaviors. The constructs of novelty seeking and rule-breaking have been studied heavily in late childhood and adolescence, although there is considerably less research on the emergence of these behaviors in early childhood. Furthermore, there is a notable lack of research on the relationship between these two variables.

Novelty seeking is frequently assessed using self-report measures. For this reason, much of the research focuses on older children who are able to accurately assess and report their novelty seeking. It is much more difficult to measure this construct in preschool-aged children as common self-report measures are designed for children in grade school who are able to read and write independently. Parent-report questionnaires are one way to assess children's temperament and personality characteristics. The Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006) and the Childhood Behavior Questionnaire (Rothbart, Ahadi, Hershe, & Fisher, 2001) are parent report questionnaires that include a High-Intensity Pleasure scale that measures novelty seeking in children ages 12-36 months. By using a parent report to measure novelty seeking in preschool age children, it may be possible to

determine whether this behavior emerges in early childhood and remains a stable trait throughout development.

Rule-breaking also commonly is studied in late childhood and early adolescence. It is believed that hormonal changes and environmental characteristics play a major role in the development of rule-breaking behavior (Harden et al., 2015; Klahr, Klump, & Burt, 2014). Rule-breaking may commonly be studied in late childhood and adolescence as these factors typically emerge as children develop. Furthermore, the structure of some parent- and self-report measures makes its detection in early childhood less evident. Measures such as the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) assess some behaviors that would not be present in many young children (e.g., theft, drinking, etc.). In fact, the CBCL only measures oppositional and defiant problems in preschool-age children, and does not address rule-breaking per se (Achenbach & Rescorla, 2001). One possible explanation is that rule-breaking is sometimes associated with delinquency (i.e., illegal rule-breaking behavior), instead of being treated as a separate behavior. However, rule-breaking is conceptually defined for the present study as defiance to rules set down by authority figures (e.g., parents, teachers). Therefore, it is likely that many children engage in rule-breaking activities in preschool and early childhood. In addition to questionnaires that may not capture the full picture, there is notably less research on objective measures of rule-breaking. This means that most research to date may be confounded by rater bias and inaccurate assessment (Petitclerc et al., 2015). Observational methods are less common and would be a valuable contribution to the literature; the current study includes observational methods as a complement to caregiver reports of rule-breaking.

Results to date have yielded conflicting views on the nature of non-aggressive rule-breaking behavior. It is possible that some of the behaviors present in rule-breaking are a

normative part of child development. Some behaviors (e.g., defiance) that are an integral part of rule-breaking may also be responsible for the development of autonomy at a young age (Wakschlag & Keenan, 2001). If this is the case, then rule-breaking should be present in the majority of children as a normative part of development. Furthermore, the judgment and emphasis placed on noncompliance in early childhood should be re-evaluated and treated as a developmental milestone. It is also possible that rule-breaking follows a specific developmental trajectory that may dissipate with time for a large majority of children. On the other hand, it may also be the case that these behaviors are indicative of future externalizing behavioral problems and should be addressed as soon as possible (Timmermans, van Lier, & Koot, 2009). Therefore, assessing the stability of rule-breaking is an important component lacking in the current literature. More research needs to be conducted on the specific components of rule-breaking and the factors that differentiate normative development from developmental psychopathology (e.g., specific behaviors, severity, frequency).

Finally, it is important to study the relationship between the two constructs of novelty seeking and rule-breaking. These behaviors appear to be connected, but there is little information on how one behavior may affect the development of the other (Jensen, Weaver, Ivic, & Imboden, 2011). It is a reasonable assumption that a child who enjoys engaging in high-risk activities may also be predisposed to engage in certain activities due to their innate novelty. Some of these novel activities may be appropriate (e.g., skydiving), whereas others may be inappropriate or illegal (e.g., stealing). Another possibility is that an underlying factor or trait contributes to the development of both novelty seeking and rule-breaking.

For this reason, novelty seeking and defiance, as measured by objective reports, were evaluated as predictors of rule-breaking in preschool-age children for this study. Additionally,

these behaviors were evaluated for potential genetic components. There is a great deal of evidence suggesting that rule-breaking and delinquency are largely influenced by the environment. However, current research does not examine the genetic etiology that may be present in preschool-age children. It is important to identify this behavior in early childhood to determine the extent of heritability and environmental influences on rule-breaking and novelty seeking. By determining the heritability of these behaviors, it may be possible to focus prevention and intervention efforts towards at-risk groups. The twin methodology that I utilized is an excellent way to further evaluate these influences. The current study sought to answer those questions.

CHAPTER 2

LITERATURE REVIEW AND CURRENT STUDY

Rule-breaking is considered the set of behaviors a child displays that defy social norms or parent demands, such as using profanity or lying (Burt et al., 2015). In contrast, delinquency consists of illegal behaviors that also defy social norms, such as truancy or theft (De Haan, Prinzie, & Dekovic, 2010). Both of these behaviors are thought to appear during late childhood and adolescence (De Haan et al., 2010; Fite, Wimsatt, Vitulano, Rathert, & Schwartz, 2012; Steinberg et al., 2008; Sullivan, 2008). There are many aspects of a child's temperament that may contribute to the development of rule-breaking behavior. One aspect of temperament that has recently been related to rule-breaking and delinquency is novelty seeking (Jensen et al., 2011). This behavior encompasses an individual's propensity for thrill seeking or adventurous activities due to their rewarding nature (Hink et al., 2013). Although some researchers have found evidence that novelty seeking is related to rule-breaking behavior, there is little research looking at these behaviors in early childhood (Jensen et al., 2011; Mann, Kretsch, Tackett, Harden, & Tucker-Drob, 2015; Van Beurden, Zask, Brooks, & Dight, 2005).

Rule-breaking and delinquency are both aspects of antisocial behavior (Niv, Tuvblad, Raine, & Baker, 2013). Some researchers consider antisocial behavior to be a spectrum with aggression being used as the main distinction between the two endpoints (Tuvblad, Eley, & Lichtenstein, 2005). Rule-breaking with and without aggression has detrimental effects on healthy adjustment and may lead to criminality during adolescence and adulthood. Whereas the predictors of rule-breaking with aggressive behavior have been heavily researched, there is far less literature on the predictors of childhood rule-breaking without an aggressive component. Additionally, it is important to differentiate developmentally appropriate behavior in early

childhood from behavior that may be indicative of future rule-breaking (McMahon & Frick, 2005). For instance, defiance may be considered a normal part of healthy independent identity formation, or it may be considered an individual's pathological need to defy authority, dependent in part upon the age of the child and severity of the behavior. This act may be consistent across several settings, but some may consider defiance to be normative, whereas others may believe it is predictive of future delinquency. For the purposes of this study, rule-breaking was conceptualized as a child's defiant behavior toward the directions and requests made by authority figures (i.e., caregivers and parents).

Non-aggressive rule-breaking and novelty seeking may both have a genetic component. The heritability of novelty seeking and rule-breaking behaviors in childhood may be considered risk factors for negative outcomes later in life. Furthermore, the presence of both behaviors may place individuals at an increased risk for poor outcomes in adolescence and adulthood (e.g., delinquency). One possibility is that individuals with increased novelty seeking may be predisposed to develop rule-breaking tendencies in early childhood. A potential interaction may exist between these two behaviors that place individuals at an even higher risk for poor outcomes.

Novelty seeking

Novelty seeking refers to an individual's propensity to engage in high-risk activities for personal enjoyment (Hink et al., 2013). Novelty seeking, thrill seeking, and sensation seeking are similar constructs with some differences. In an attempt to capture the full spectrum of high-intensity activities, this project incorporated information from all of these constructs and used the term novelty seeking. There are a number of theories concerning the etiology of novelty seeking, with some focusing on environment and others implicating genetic and biological

factors. Many researchers have linked increased novelty seeking to the adolescent period of development and puberty (Littlefield, Stevens, Ellingson, King, & Jackson, 2016; Steinberg et al., 2008). The connection between age and novelty seeking may be due to pubertal hormones that begin to increase as one reaches adolescence; this may account for the curvilinear pattern of novelty seeking sometimes seen throughout development (Steinberg et al., 2008). Novelty seeking constitutes a temperamental or personality characteristic present in many well-adjusted individuals, but it has been linked to negative outcomes in adolescence and adulthood (Jensen et al., 2011; Mann et al., 2015).

Some researchers believe that novelty seeking is due to the earlier maturation of the socio-emotional system and a relatively under-developed cognitive control system (Peach & Gaultney, 2013). In line with that hypothesis, researchers have shown that the combination of high sensation seeking and low impulse control may be responsible for increased risk taking in young adults (McCabe, Louie, & King, 2015). This dual systems model helps to explain why novelty seeking commonly appears during adolescence and decreases after adolescence as the frontal lobe continues to develop (Peach & Gaultney, 2013). Some researchers have found that novelty seeking has a genetic component in teenagers and adults and is related to functioning in specific parts of the brain (Bratko & Butković, 2003; Gallinat et al., 2007). Novelty seeking should follow a specific developmental trajectory that begins after early childhood based on these findings.

It is possible that other factors, in addition to specific brain structures, contribute to the development of novelty seeking. Researchers in one study used a twin sample to find that individual differences in some subtypes of sensation seeking were highly heritable, with some individuals being more susceptible to their environmental influences (Stoel, De Geus, &

Boomsma, 2006). The relationship between DRD4, a dopamine receptor gene commonly associated with aggression and other externalizing behaviors, and environment (e.g., income, neighborhood, and maternal education) may result in an interactive gene-environment effect on the expression of novelty seeking in adulthood (Lahti et al., 2006). Therefore, it may be a combination of factors (i.e., brain functioning, genes, and environment) that lead to the development of novelty seeking.

Novelty Seeking and Development

Earlier precursors of novelty seeking may be present even though this behavior becomes more noticeable during adolescence. These early indicators of novelty seeking may appear different due to the age of the child. Novelty seeking has previously been thought to appear during adolescence, but some researchers sought to evaluate the possible presence of novelty seeking behavior in 3-month-olds (Laucht, Becker, & Schmidt, 2006). These researchers found that infants who habituated more quickly to visual stimuli scored higher on novelty seeking at an older age indicating that it is possible to measure novelty seeking behaviors early in life (Laucht et al., 2006). Early indicators of novelty seeking behavior coupled with novelty seeking traits in adulthood indicate that the behavior may be a more stable personality trait (Laucht et al., 2006; Reio Jr. & Choi, 2004).

There is some debate as to whether novelty seeking and impulsivity are related or if novelty seeking is a specific subtype of impulsivity. Impulsivity has many characteristics similar to novelty seeking, which makes it important to distinguish between the two when further evaluating these constructs in a research setting. In fact, novelty seeking and impulsivity are temperamental characteristics that share many important characteristics. Both impulsivity and novelty seeking may appear to be similar in childhood and be associated with adolescent risk

taking (Romer, 2010). When evaluating young children, it is important to differentiate between traditional impulsivity and novelty seeking. Researchers have found that novelty seeking appears to peak in adolescence and then level off, whereas impulsivity has a tendency to linearly decline throughout development after age 10 (Steinberg et al., 2008). Another study indicated that novelty seeking appears to peak during adolescence and has decreased rates in childhood and adulthood, although impulsivity tends to stay stable throughout childhood (Peach & Gaultney, 2013). Although both of these studies seem to represent the similarities between impulsivity and novelty seeking, the developmental trajectories of these constructs are different, indicating they are similar but distinct behaviors. Impulsivity and novelty seeking have clearly been identified as separate behaviors, although the exact relationship between them remains unclear. Additionally, the etiologies of impulsivity and sensation seeking appear to be different, with impulsivity indicating a deficit in executive functioning, which is not the case in novelty seeking (Romer, 2010).

Whereas novelty seeking is generally thought to be a heritable, innate core of an individual's personality, some research suggests that it is strongly influenced by the environment, especially stressors in the environment (Keltikangas-Järvinen, Räikkönen, Ekelund, & Peltonen, 2004). Individuals with a two or five repeat allele of dopamine receptor D4 (DRD4) may carry a risk factor for novelty seeking (Keltikangas-Järvinen et al., 2004). These particular alleles of the DRD4 receptor gene appeared to have enhanced the novelty seeking traits of participants at ages 20-29 only when they experienced a hostile authoritarian parenting style during youth, at ages 6-15 (Keltikangas-Järvinen et al., 2004). Life stressors, such as abuse and neglect, appear to have a relatively strong influence on adolescent risk taking behaviors (Romer, 2010). These studies demonstrate that high novelty seeking may turn into

deviancy when exacerbated by environmental factors such as limited parental involvement and high peer delinquency (Mann et al., 2015).

Measurement of Novelty Seeking

There are numerous ways to measure novelty seeking in adolescence using self-report measures. There is less literature assessing this behavior in younger children. Many measures use a short scale that evaluates an individual's propensity and attitude toward engaging in novel situations (Jensen et al., 2011; Trice, 2010). Other studies have simply used a single question aimed at an individual's desire to take risks (Peach & Gaultney, 2013). More comprehensive measures of novelty seeking use a four-factor model, assessing thrill seeking, disinhibition, boredom susceptibility, and experience seeking (Gallinat et al., 2007; Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2010; Trice, 2010). Parent and teacher reports are available for children as young as 6 years old, whereas self-reports are typically available beginning at age 10 (Donfrancesco et al., 2015). Although many novelty seeking specific questionnaires exist for older children, there are also numerous parent-report forms that measure children's temperament characteristics, including novelty seeking behaviors (Rothbart et al., 2001). When measuring temperament, it is important to distinguish between a child's response to stimuli and specific novelty seeking behaviors. For example, approach refers to the child's excitement in anticipation of pleasurable activities, whereas high intensity pleasure refers to the child's desire to engage with stimuli due to their intensity and novelty (Rothbart et al., 2001). The Child Behavior Questionnaire (CBQ) includes a High-Intensity Pleasure scale that appears to capture the basic principles of novelty seeking in children 3-7 years old (Rothbart et al., 2001). Although most measures consist of questionnaires, novelty seeking has been evaluated in 3-month-old children using a visual selectivity and habituation design (Laucht et al., 2006). The

use of observational tests may provide an important complement to the widely used questionnaire measurements as they offer a different perspective on novelty seeking. These types of tests are relatively limited in young children, especially during preschool age.

When using a measure to evaluate novelty seeking in young childhood, it is important to distinguish it from other forms of impulsivity and novelty seeking (Romer, 2010). In fact, 3 distinct forms of impulsivity- impatience, action without thought, and novelty seeking- may be seen in individuals (Romer, 2010). Although all three forms fall under the overarching construct of impulsivity, novelty seeking is a distinct and separate behavior as demonstrated by its distinctive consequences and etiology (Romer, 2010).

Negative Consequences of Novelty Seeking

Novelty seeking has been associated with rule-breaking behaviors in childhood (Jensen et al., 2011). Although those who exhibit sociable traits before age 5 were shown to have displayed higher rates of alcohol problems at age 15, this pathway appears to be mediated by extraversion and sensation seeking in both males and females (Dick et al., 2013). Some negative behaviors seen in early childhood may be thought of as relatively inconsequential, but novelty seeking has been associated with more serious, delinquent behaviors in adolescence, such as riding with an intoxicated driver and drinking heavily during adolescence (Van Beurden et al., 2005). Novelty seeking has also been associated with health-related risk-taking, such as the intention to begin smoking and smoking behavior (Jackson, Poly, & Obispo, 2012). Thus, novelty seeking has demonstrated a relationship with risk-taking behaviors that may negatively impact health and well-being during adolescence.

In addition to playing a role in risk-taking behavior in adolescence and adulthood, novelty seeking has also been related to psychopathology in childhood. Novelty seeking appears

to be a component of externalizing behaviors in childhood, such as Attention Deficit Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD) (Donfrancesco et al., 2015; Melegari et al., 2015). This correlation is still present even when controlling for impulsivity-related items used to diagnose these disorders (Donfrancesco et al., 2015). This highlights the importance of evaluating novelty seeking and its implications in childhood, as well as long-term outcomes in adolescence and adulthood.

Antisocial behavior: Rule-breaking and delinquency

There is notably less research on rule-breaking as compared with other externalizing behaviors such as delinquency. Delinquency can be conceptualized into distinct categories (e.g., stealing, violence, damage to property) and may demonstrate some similarities to rule-breaking (Wiesner, 2003). There is some evidence to suggest that externalizing problems seen in early childhood may be related to later rule-breaking and delinquent behaviors seen in adolescence (Wakschlag et al., 2014). On the other hand, some noncompliance during young childhood may be an indicator of appropriate identity development (Wakschlag et al., 2014). For example, a child may lack responsiveness to their parent due to the child's desire to carry out a particular action consistent with their interests. This may be a form of independent development, in contrast to an action where the intent is solely to defy their parent and display oppositional behavior. Although the literature does distinguish between intentional oppositional characteristics and temperamental differences (Althoff, Kuny-Slock, Verhulst, Hudziak, & Van Der Ende, 2014), it does little to link these behaviors to later rule-breaking. This discrepancy stresses the importance of identifying rule-breaking behavior early in childhood and simultaneously discerning maladaptive behavior from developmental norms.

Rule-breaking consists of behaviors that defy social norms and rules set forth by

authority figures, such as lying (Burt, Donnellan, Slawinski, & Klump, 2015). Age may play an important role in the developmental trajectory of rule-breaking. Higher levels of rule-breaking (e.g., swearing, stealing, lack of guilt) have been observed in older children (Fite et al., 2012). Furthermore, the negative effects of rule-breaking in childhood may also be contingent upon the age of the individual, with older individuals experiencing more negative consequences because of the potential impact on their school performance and peer interactions (Fite et al., 2012). The effects of socialization and peers on rule-breaking further indicate that age and developmental progression may play a role in rule-breaking, as peer rejection may serve as a mediator between rule-breaking and academic performance (Fite et al., 2012).

Measurement of Rule-Breaking

Although rule-breaking is not commonly studied in young children, there are measures and behavioral coding schemes aimed at identifying these behaviors for this age group. For young children, parent and teacher reports are typically used to assess a wide variety of behaviors (Deater-Deckard & Petrill, 2004; Klahr, Klump, & Burt, 2014). The Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) is a frequently used questionnaire that ascertains problems consistent with the Diagnostic and Statistical Manual (DSM) (Achenbach & Rescorla, 2001). The CBCL has been validated to use with individuals from 1½ to 18 years of age (Achenbach & Rescorla, 2001). The pre-school version of the CBCL (ages 1½ to 5) has an Oppositional Defiant Problems scale, but does not have a scale that measures rule-breaking for this age group (Achenbach & Rescorla, 2001). Some studies have used multiple informants -- parent, teacher, peer, and self-reports -- in an attempt to get an accurate and well-rounded assessment of rule-breaking behavior in older childhood (Ettekal & Ladd, 2015). Parent and teacher reports are available for children ages 1½-18, whereas self-report forms are available for

youth beginning at age 11 (Achenbach & Rescorla, 2001). Although children may be aware of rule-breaking behavior at a young age, self-report measures typically begin in adolescence. The restrictions on age are likely due to the ability of a young child to accurately read and comprehend the questions on the survey, as well as define their own behavior according to the survey questions.

The CBCL and other questionnaires assessing delinquency and externalizing behavior in childhood are frequently used, as they are cost effective and easily interpreted. Few researchers have evaluated rule-breaking in young children using a different methodology. Some researchers have used in-lab parent-child interaction data and behavioral coding to evaluate compliance and rule-breaking behaviors during a testing session in children ages 12-24 months (Dix, Stewart, Gershoff, & Day, 2007; Marceau et al., 2012). This type of methodology offers the added benefit of evaluating behavior from an objective perspective in a controlled setting. Although behavioral coding has been used to evaluate certain behaviors, the literature comparing these objective means to self-report measures is even sparser. One aim of the current study is to compare new objective measures of rule-breaking with parent-report questionnaires to determine the accuracy of these assessments.

Although rule-breaking and delinquency have been assessed through the use of questionnaires and objective observations, there is no agreed upon determination on the best method to accurately measure these behaviors. Parents may have a bias due to their level of communication with the child, as well as their perception of the child's behavior as normative or atypical. Parent-child interactions and communication may influence a parent's ability to accurately report children's behavior (Laird & LaFleur, 2014). However, parents who monitor their children more often have parent reports more consistent with child self-reported behavior

(Laird & LaFleur, 2014).

Another consideration when evaluating bias in reporting may be the setting in which the behavior takes place. Parents who see their children all day across a number of settings may differ in their reports of externalizing behavior when compared to teachers who see the child for several hours a day only in a classroom setting. This difference in scores may be related to environment; however, the type of reporter may also play a role. There have been differences in the observed measure of externalizing behavior in preschool children based on the type of reporter (i.e., parents vs. teacher; Petitcherc et al., 2015).

When examining raters in the same environment it could reasonably be assumed that two different observers would give similar scores. For example, two teachers in the same classroom should theoretically have similar reports of externalizing behavior in preschoolers since they are measuring the same children in the same setting. However, researchers in one study demonstrated that teachers and teachers' assistants have different assessments of child behavior even though they are in the same environment (Wolcott & Williford, 2015). This may be due to a number of factors, including reporter bias in the perception of normative behavior, as well as the possibility that the two teachers, although in the same classroom, are actually measuring different behaviors (Wolcott & Williford, 2015). Thus, even questionnaires that appear to come from reliable and unbiased sources can be imperfect.

One important question to consider when using questionnaires as an assessment of child psychopathology is whether the questionnaire is accurately assessing the targeted behaviors. Many of the questionnaires designed to address these concerns measure a wide array of externalizing behaviors in young children. Therefore, when using measures to assess rule-breaking it is vital to ensure that researchers are assessing the oppositional and defiant behaviors

that are present in this behavior. The CBCL has a specific rule-breaking category, as well as a more overarching category that is inclusive of all externalizing behaviors (Achenbach & Rescorla, 2001). Other questionnaires, such as the Children's Social Behavior Questionnaire (CSBQ; Hartman, de Bildt, & Minderaa, 2013) and Eyeberg Child Behavior Inventory (ECBI; Eyeberg & Pincus, 1999), have also been used to measure externalizing behavior in young children (Burns & Patterson, 2000; Pelletier, 2006). These questionnaires have found that three factors generally emerge when evaluating externalizing behavior in young children, and that oppositional and defiant behavior is distinct from other forms of externalizing behavior (Cohn, Van Domburgh, Vermeiren, Geluk, & Doreleijers, 2012; Hodgins, Larm, Ellenbogen, Vitaro, & Tremblay, 2013). All of these factors underscore the importance of accurate assessments to determine the presence of rule-breaking in young children, as well as the various factors that may influence scores.

Aggression and Rule-Breaking

It is important to differentiate between the various aspects of antisocial behavior as well as between different forms of externalizing behaviors when assessing rule-breaking. Rule-breaking and aggression have some similarities and both fall on the antisocial behavior spectrum. They appear to be distinct behaviors with an underlying characteristic, general antisocial behavior, that may be heritable (Niv et al., 2013). Despite their connection to general antisocial behavior, other factors demonstrate that these behaviors have somewhat different etiologies. This indicates that these behaviors represent two different constructs with some commonalities (Burt, 2012a).

It was previously believed that age of onset was one of the most important predictors for the severity and course of adult antisocial behavior (i.e., callous unemotional traits that tend to

develop in early childhood). However, aggression and rule-breaking in teenagers have been shown to predict adult antisocial behavior better than age of onset (Burt et al., 2011). Without taking into account severity, both aggressive and non-aggressive rule-breaking are indicative of later adolescent delinquent behavior (Tuvblad et al., 2005). Therefore, it is important to determine whether rule-breaking behaviors during preschool are a precursor for more serious stable delinquent behavior, or if these behaviors will lessen with development (McMahon & Frick, 2005).

Oppositional Behaviors and Rule-Breaking

There are different types of rule-breaking, but a common thread may be the presence of oppositional behavior. This may be present through defying the commands of parents, being unresponsive to requests, lying, and stealing. For preschool-aged children, it is likely that oppositional behavior may be developmentally seen as negative behaviors, such as a lack of responsiveness to and defiance of others' requests (e.g., parents, siblings). Oppositional behavior can be defined as being easily irritated, having an inability to control temper, defying the requests of one's parents, and generally refusing to obey the directions of one's parents (Wakschlag & Keenan, 2001).

Oppositional behavior and refusal to follow the commands of authority figures may be considered to be more or less developmentally inappropriate depending on one's age (Wolcott & Williford, 2015). Another factor that may contribute to the perception of defiance as a normative versus problem behavior may depend on the frequency and severity of the behavior (Wakschlag, 2004). For example, verbal defiance and a refusal to participate in an undesired activity at times may be considered normative, whereas persistent defiant behavior demonstrated by extreme outbursts may be indicative of psychopathology or non-normative behavior.

Furthermore, studies have demonstrated that oppositional behavior is present in young childhood and can be differentiated from other forms of externalizing behavior, such as hyperactivity (Burns & Patterson, 2000; Pelletier, 2006). When evaluating whether oppositional behaviors are normative or problematic, the perceptions of individual observers may play an important role (Wolcott & Williford, 2015). To a certain extent, this calls into question the validity of assessing behaviors like opposition in early childhood as precursors to pathological and harmful behaviors later in life. If these developmentally appropriate behaviors are pathologized, children's normative development may be unfairly punished or children may be misdiagnosed with a psychological disorder early in life.

Some have suggested that defiance during childhood may indicate a child is experiencing healthy development and a sense of autonomy (Dix et al., 2007). In fact, when evaluating clinical versus nonclinical samples, the majority of children without clinical diagnoses displayed actions consistent with conduct and oppositional behavior (Burns & Patterson, 2000). Within that sample there was a small subset of young children who endorsed several items indicating a high severity of these behaviors (Burns & Patterson, 2000; Pelletier, 2006). This demonstrates that many children in the general population may display oppositional and defiant behavior, although it is only problematic in a small subset of children who demonstrate severe or persistent negative behaviors.

Moreover, one can differentiate between legal rule-breaking, which is considered in the present study, and illegal rule-breaking that may be indicative of delinquent behaviors. Legal rule-breaking may be considered to be more inclusive of oppositional and defiant behavior towards persons in a position of authority, such as lying (Burt, Donnellan, Slawinski, & Klump, 2015). This form of rule-breaking has been shown to be present in children who display rule-

breaking at both clinical and nonclinical levels. Legal rule-breaking may share many commonalities with oppositional and defiant behavior towards parents or authority figures. Illegal rule-breaking, on the other hand, encompasses behaviors such as vandalism and stealing. These behaviors are not commonly seen in children who have subclinical levels of antisocial behavior, but were present in some children who met the clinical diagnosis for rule-breaking (Burt, 2012b).

Some low intensity negative behaviors, such as stealing and lying, have been shown to be present in both typically developing and disordered groups of preschool children, whereas high intensity behaviors, such as high defiance and aggression, may indicate future onset of conduct disorder (Hong, Tillman, & Luby, 2015). Furthermore, different forms of oppositional behaviors may indicate different outcomes in the future. For example, children who display irritable behavior may be at risk for developing internalizing disorders as adults, whereas those who display defiance may have an increased risk for later violence in adulthood (Althoff et al., 2014). Certain extreme temperamental traits have been associated with psychopathology in children, as well as negative outcomes for those children (Martel, Gremillion, & Roberts, 2012). Thus, behaviors that are not illegal but violate societal or parental norms may be predictive of future problem behaviors in adolescence and adulthood. If legal rule-breaking is indicative of future problem behaviors and atypical development, then it is conceivable that this may escalate into delinquent and illegal rule-breaking behavior. It is possible that these negative oppositional behaviors may be normative or pathological depending on the situation and severity.

Development of Delinquency

Rule-breaking and delinquency may be thought of as two forms of externalizing and antisocial behaviors present throughout development. There are not many studies that evaluate the differences between legal rule-breaking and delinquent behaviors before adolescence (Burt et al., 2015). In contrast to some forms of legal rule-breaking, delinquency is considered to include covert behaviors that violate a law or societal norms, such as truancy and theft (De Haan et al., 2010). There is a small proportion of youth who engage in problem behavior at ages 4-6 years and continue to exhibit this behavior throughout development; these children typically go on to engage in delinquency at 10-12 years of age (Sullivan, 2008). Other non-normative behaviors, such as displaying hurtful actions toward others without care or remorse at ages 6-10, may be more likely to predict criminality at age 24 (Hodgins et al., 2013). On the other hand, not all children who exhibit problem behavior in childhood will go on to engage in delinquency. Emotional and behavioral indicators may not always be accurate precursors of future problematic behavior (Sullivan, 2008). There is a lot of research that still needs to be done to identify normative versus pathological behaviors during childhood.

Researchers have come a long way in identifying specific behaviors in childhood that may indicate future delinquency in adolescence and adulthood, although there is still more work to be done. Whereas some oppositional and rule-breaking behaviors may predict later delinquency in some cases, only extreme behaviors (e.g., stealing, cheating, failure to follow social norms) have been shown to be highly effective in prediction (Mallett, Stoddard Dare, & Seck, 2009). In some circumstances (e.g., environments without child maltreatment) internalizing disorders, such as depression, during childhood have been associated with delinquency at ages 14-17 (Mallett et al., 2009). Although this interaction between internalizing

psychopathology (e.g., depression) and environment may seem illogical (i.e., externalizing behavior is typically related to delinquency), it highlights the complex nature between these two factors when evaluating long-term outcomes.

It appears that delinquency follows a different developmental trajectory than other externalizing behaviors commonly seen in childhood. Whereas aggression appears to decrease throughout development, delinquency is less prevalent in childhood and then increases in adolescence (De Haan et al., 2010). The majority of children evaluated for delinquent and criminal behavior before age 12 demonstrate a decrease in delinquency throughout development (Geluk et al., 2014). A small subgroup of children with high levels of problems in childhood that led to future delinquency displayed hyperactivity and impulsivity in childhood, as well as environmental problems present in their family and peer groups (Geluk et al., 2014). This indicates that although some delinquent behaviors during childhood are normative and decrease with development, others display a more persistent course of delinquency that is associated with hyperactivity, impulsivity, and a negative environment.

Rule-breaking, Delinquency, and Genetics

Rule-breaking and its ability to predict adolescent delinquency may be moderated by genetic or environmental factors. Aggression, oppositional behavior, and disruptive behavior (i.e., aggressive disruptiveness) in young children have been moderated by peer interactions (Ettekal & Ladd, 2015). Specifically, peer rejection and time spent with delinquent peers mediated the relationship between aggressive disruptiveness and later rule-breaking (Ettekal & Ladd, 2015). Aggressive disruptiveness appears to be predictive of rule-breaking later in life. Evidence suggests this behavior may lead to negative peer relationships and delinquent friendships that account for the development of future rule-breaking (Ettekal & Ladd, 2015).

There may be as many as three different subtypes (i.e., low, moderate, and serious) of delinquent behavior present in adolescence that indicate different levels of severity and predisposition for criminal behavior later in life (Hasking et al., 2011). Some researchers have used measures that evaluate callous, unemotional traits in adolescence, which are generally considered to be more severe and lead to worse outcomes than conduct disorder (Essau, Sasagawa, & Frick, 2006). In fact, the measurement of callous, unemotional traits has proven to predict antisocial outcomes above and beyond those predicted by traditional conduct disorder behavior indicating that the measurement of these behaviors is exceptionally important (McMahon, Witkiewitz, & Kotler, 2010). Furthermore, various dimensions of delinquent behavior have been differentially linked to genetic and shared environment etiologies (Kendler, Aggen, & Patrick, 2013). Antisocial behavior that begins in early childhood has demonstrated high heritability as measured by multiple informants, demonstrating that more chronic and persistent antisocial behavior may be somewhat genetic in origin (Arseneault et al., 2003). Rule-breaking and overt aggressive actions have been shown to be more related to genetic factors, whereas covert actions of delinquency have been linked more to shared environment (Kendler et al., 2013).

Rule-breaking, Delinquency, and Environment

Many researchers have typically assumed that the cause of rule-breaking and delinquent behaviors is primarily environmental. Maternal negativity and other external factors have been linked to non-aggressive rule-breaking in children (Klahr et al., 2014). Due to the complex etiology of human behavior, most behaviors appear to have both an environmental and genetic component to them (Plomin, DeFries, Knopik, & Neiderhiser, 2013). Children who display aggressive rule-breaking appear to experience an evocative gene-environment correlation (rGE)

process wherein their genetic expression of aggression elicits a negative response from their mother (Klahr et al., 2014). In contrast, children with non-aggressive rule-breaking may not experience this same maternal negativity; environment factors seem to be the primary cause of this rule-breaking behavior (Klahr et al., 2014). Although there is little research available on the nature of this interaction, it is possible that parents' lack of response to non-aggressive rule-breaking behaviors may seek to foster normal development among what may be considered typical childhood misbehavior (Klahr et al., 2014).

Some researchers have found the variance in self-reported delinquency is between 0% and 45% genetic, with between 59 and 100% of the variance in delinquency accounted for by non-shared environment (Connolly & Beaver, 2014). This indicates that although rule-breaking may have a genetic component, environment may have a more salient impact. Non-aggressive rule-breaking is more frequently associated with impulsivity and is not considered to be as heavily influenced by genetics as aggression, although impulsivity itself is likely highly genetic (Burt, 2012a). On the other hand, aggressive rule-breaking is largely accounted for by genetic factors and is more stable throughout child and adolescent development (Burt, 2012a).

Thus, environment is an important consideration when evaluating the presence of rule-breaking in young children. Both shared (an environment that is the same for two family members; e.g. siblings share the same parents) and non-shared environment (an environment that is different for two family members; e.g. children are in different classrooms at school) are indicated in the development of rule-breaking behavior (Marceau et al., 2012). Furthermore, a predisposition toward non-aggressive rule-breaking may be moderated by prosocial peer interactions (Burt & Klump, 2014). Prosocial interactions are defined as affiliations with peers that influence the child's behavior in a positive manner (Klahr et al., 2014). Individuals who had

lower levels of interactions with prosocial peers appeared to have greater genetic influences on their non-aggressive rule-breaking behavior than individuals who experienced a large number of prosocial interactions (Burt & Klump, 2014). Furthermore, in adult samples, neighborhood has been shown to impact non-aggressive rule-breaking while having no impact on aggressive behaviors (Burt, Klump, Kashy, Gorman-Smith, & Neiderhiser, 2015). Researchers in one study found that a specific neighborhood had no effect on aggression; this neighborhood did account for 11% of the variance in non-aggressive rule-breaking (Burt et al., 2015). The effect of neighborhood on non-aggressive rule-breaking was partially explained by social interactions and structural processes within the neighborhood (Burt et al., 2015). One possible explanation for the effect of neighborhood on rule-breaking may be that environment plays a bigger role in the etiology of rule-breaking compared to aggression (Burt et al., 2015).

On the other hand, there may be a genetic component to rule-breaking, and the environment may impact the level of genetic expression (Legrand, Keyes, McGue, Iacono, & Krueger, 2008). Shared environment, nonshared environment, and genetics contribute to 100% of a person's behavior (Plomin et al., 2013). This means that if the relative importance of certain contributors become more salient (e.g., shared environment and genetics), this will increase the proportion of those contributors and decrease the proportion of other contributors (e.g., nonshared environment). One study found that the genetic component of rule-breaking was more important in urban areas where there was more opportunity for personal decision making, leading to higher levels of genetic expression (Legrand et al., 2008). This demonstrates the likelihood that rule-breaking has both a genetic and environmental component. (Niv et al., 2013). In one study on rule-breaking and aggression, researchers found that the genetic influence on externalizing behavior was as high as 38.4%, although shared environment still played a

significant role (Burt, 2012a). Other researchers have found similar rates (i.e., 45%) of heritability in delinquency (Connolly & Beaver, 2014).

Genetic influences on rule-breaking behavior may also be mediated by age and gender. Although early behavior genetic studies showed virtually no genetic effect on adolescent delinquency (DiLalla & Gottesman, 1991), one recent study found that the genetic influence on delinquent behaviors in adolescence tripled from ages 10 to 15, whereas the influence of shared environment during this age group became almost nonexistent (Burt & Neiderhiser, 2009). This may be an indication of an active rGE, where an individual seeks out an environment compatible with their genotype (Burt & Neiderhiser, 2009). Gender effects on the genetic expression of individuals have also been noted in the behavioral genetics literature. Genes may mediate the relationship between childhood rule-breaking and adolescent delinquency for females but not males (Tuvblad et al., 2005). One hypothesis about this gender difference is that common delinquency scales may include covert behaviors (e.g., lying) that are more traditionally consistent with behaviors seen in females (Tuvblad et al., 2005).

Relatedly, environment has been found to mediate the relationship between genetic predisposition and rule-breaking in male samples living in urban areas, possibly due to a less restricting environment where personal choice allows for greater genetic expression (Legrand et al., 2008). One potential explanation regarding this interaction is that societal expectations for behavior differ by gender, with fewer expectations placed on males, allowing their genetic material to be expressed without strict constraint (Legrand et al., 2008). It is clear that environment, gender, and genetic expression may all play a role in the development of rule-breaking and delinquency, although the interaction between these factors is somewhat contradictory and remains unclear.

Twin Studies and the Heritability of Behavior

Because there is little research on the heritability of rule-breaking, I will discuss the heritability of externalizing behaviors more generally, a more global but related behavior. There are several ways to study the heritability of externalizing behavior in young children. Perhaps one of the most commonly utilized due to its low cost and practical application are twin studies. There are two distinct types of twin pairs, monozygotic (MZ) and dizygotic (DZ). MZ twins are fertilized from the same egg and thus share nearly 100% of their DNA (Plomin et al., 2013). DZ twins result from two separate eggs that are fertilized by 2 separate sperm at the same time and thus share approximately 50% of their DNA (Plomin et al., 2013). Twin studies measure the amount of similarity between MZ twins and DZ twins in order to calculate heritability (DiLalla, Elam, & Smolen, 2009).

Many studies have utilized twin methodology to look at externalizing behavior in young children (Burt & Neiderhiser, 2009; DiLalla, Bersted, & John, 2015; Niv et al., 2013). Zygosity of twins can be determined using DNA samples that are taken from the siblings. Also, a very accurate and cost effective way to determine twin zygosity is to use a questionnaire that is filled out by the parents that assesses child characteristics, such as hair and eye color (Plomin & Rowe, 1977; Van Hulle, Lemery-Chalfant, & Goldsmith, 2007). The accuracy of using physical characteristics to identify zygosity, when compared to traditional DNA analyses, is over 90% (Plomin & Rowe, 1977).

It is important to consider three specific gene-environment correlations -- active, passive, and evocative -- when evaluating how genes are expressed based on the child's environment and developmental level (Scarr & McCartney, 1983). A passive gene-environment correlation is common in early childhood where the biological parents pass down both genetic and

environmental traits to their young children (Scarr & McCartney, 1983). This is present when a mother who enjoys reading provides a soothing and educational environment for her young child to read, as well as a genetic predisposition for this behavior. An evocative gene-environment correlation is present throughout the entire duration of development and is seen when a person's genetic material evokes a specific response from another individual (Scarr & McCartney, 1983). An example of this would be a child who is temperamentally prone to crying and evokes frustration from their parent. This may lead to a more hostile parenting environment that was elicited due to the child's innate temperament. An active gene-environment correlation may be present at a young age, but typically becomes more prevalent during adolescence and throughout adulthood. This is seen when an individual seeks out an environment consistent with their genetic predisposition (Scarr & McCartney, 1983). A common example of an active gene-environment correlation would be when an individual chooses to play on a basketball team due to their genetic predisposition for athleticism and thus has an athletic environment in adulthood. This is important for the current study as environment has typically been seen as a risk factor for rule-breaking; however, another consideration is that rule-breaking may elicit a certain environmental response from caregivers and peers.

Twin studies are an excellent methodology for studying rule-breaking in young children due to their ability to estimate the genetic and environmental components of a behavior. Sibling and twin pairs have been used in the past to determine the heritability of specific behaviors from birth to death (Burt & Neiderhiser, 2009). Twin studies allow researchers to assess the impact of genetic and shared environment on the development of specific behaviors. Although rule-breaking is typically considered to be largely environmental in nature, the use of twin methodology allowed me to assess the genetic influence on this behavior. Furthermore, the

longitudinal nature of this study allowed me to determine the stability of these behaviors throughout early childhood and adolescence.

Current study

To summarize, there is a fair amount of research on both novelty seeking and rule-breaking throughout late childhood and adolescence. However, there is notably less research on these constructs in early childhood, specifically before school age. The current study evaluated novelty seeking and rule-breaking during preschool, at ages 3-5 years, as well as how they predicted to later rule-breaking behavior. Additionally, this study sought to determine how novelty seeking and rule-breaking are related in childhood. Furthermore, an objective measure (behavioral coding) of defiance was developed to offer an additional perspective that was not biased due to pre-existing relationships with the child. Defiance was assessed because it incorporates oppositional behavior towards others and other negative behaviors (e.g., irritation, aggression) and should have been an important component of rule-breaking. Both objective and self-report measures were utilized to evaluate the stability of novelty seeking (ages 3-4) and rule-breaking (age 5 and follow-up at ages 6-16) throughout childhood and adolescence. Lastly, this study examined the heritability of both novelty seeking and rule-breaking in early childhood.

Hypothesis 1

There is mixed research on the developmental trajectory and stability of both novelty seeking and rule-breaking. This hypothesis evaluated the stability of both novelty seeking and rule-breaking beginning in childhood and continuing through adolescence. A defiance construct was composed of observed behaviors seen during the parent-child interaction (number of minutes parent discipline was needed, responsiveness to parent, number of minutes on task, and negative affect) at age 5, and this measure allowed me to determine the impact of defiance on

rule-breaking.

Hypothesis 1A. Novelty seeking at age 3 would be significantly correlated with novelty seeking at age 4.

Hypothesis 1B. Defiance observed at age 5 would be predictive of caregiver ratings of rule-breaking behaviors at age 5 and at follow-up, ages 6-16. Additionally, parent ratings of rule-breaking at age 5 would be predictive of caregiver ratings of rule-breaking behaviors at follow-up, ages 6-16.

Hypothesis 2

There would be a significant genetic component to novelty seeking at ages 3 and 4 and rule-breaking and defiance at age 5.

Hypothesis 3

This hypothesis tested the relationships among novelty seeking and rule-breaking in young childhood. I hypothesized first that preschool novelty seeking and defiance at age 5 would predict rule-breaking at ages 5 and at follow-up. Additionally, I hypothesized that there would be a significant interaction between levels of novelty seeking and defiance as they impacted caregiver ratings of rule-breaking. Specifically, children who displayed high levels of novelty seeking at ages 3 and 4 and demonstrated more defiance during the parent-child interaction at age 5 would have higher scores on caregiver ratings of rule-breaking at ages 5 and follow-up.

CHAPTER 3

METHODS

Participants

This study was comprised of both archival and active data collection. All data at ages 3, 4, and 5 were from an archival data set. Most data from follow-up were from the archival data set; an additional 14 participants were actively collected for recruitment into my thesis study. Individuals from the current study were participants in the Southern Illinois Twins/Triplets and Siblings Study (SITSS; DiLalla, 2002; DiLalla, Gheyara, & Bersted, 2013) at Southern Illinois University Carbondale. Participants consisted of twin pairs and triplet sets from the Carbondale and surrounding areas. Many of the SITSS families participated in testing yearly at ages 1-5 within one month of their birthday. Some families were unable to complete testing at certain ages due to late recruitment in the study and other extenuating circumstances (e.g., inability to make it within their birthday month, scheduling conflicts). Children who were diagnosed with a developmental delay, social interaction delay, Autism Spectrum Disorder, or families who missed testing at ages 3 and 4, or 5 were excluded from the current study. In 2002-2004, 2009-2010, and 2012-2013, three follow-up studies were conducted with children who were previously a part of the SITSS sample at ages 1-5. The first was in 2002-2004, called simply the follow-up study because it was the first of its kind. The second was in 2009-2010 and was called the EGO study because it was the study of an eye-gaze operant (EGO) task. The third was called the Emotion study, because it was a study of emotions. Researchers from these studies collected follow-up data once when the twins were between the ages of 6-16 years old, and some of these data were used for the current study. If children were tested during two different follow up studies, I selected children from the most recent follow-up study, which was at their oldest age.

The average age of children in the follow-up studies was 8.43 years ($SD = 2.08$).

The current study included participants who completed testing at ages 3 or 4, age 5, and three follow-up studies for children aged 6-16, plus my thesis study. If the families did not attend any of these testing sessions they were excluded from the proposed study. Due to the limited number of families that completed testing at all four time points, different hypotheses used every available twin pair taken from the overall thesis sample. Based on these criteria, 592 participants were included in this study in at least one hypothesis (see Table 1). The present sample was compared to the overall SITSS sample and significant differences were found between the two groups. Based on the parent information provided the present sample included 95 monozygotic twins, 186 dizygotic twins, 273 males, 319 females, 515 European Americans, 25 African Americans, and 32 child who identified as other races; some could not be calculated due to missing parent report.

Measures

Demographic questionnaire

All SITSS families were asked to fill out a demographic questionnaire form (Appendix A) at ages 3, 4, and 5 and follow-up. The demographic questionnaire assessed family structure, indicating the number of parents in the household and birth order of all siblings in the family. Parent education was assessed using a 5-point Likert-type scale (1 = some high school to 5 = Master's degree or higher). The Hollingshead index (Bonjean, Hill, & McLemore, 1967) was used to evaluate parent occupation (1 = unskilled laborer to 7 = high level professional). Additionally, parents reported their combined yearly annual income that was scored on a 19-point scale (1 = less than \$5,000 to 19 = over \$90,000). Parents were able to self-identify their race, as well as their children's races, which was then organized into distinct categories.

Descriptive statistics for children in the present sample can be seen in Table 2.

Early Childhood Behavior Questionnaire (ECBQ)

The ECBQ (see Appendix B for High-Intensity Pleasure scale items; Putnam et al., 2006) is a parent-report form that is used to assess the temperament of children ages 18-36 months. This questionnaire was given to the parents of children at ages 2 and 3 in the SITSS sample, but the present study used the data from age 3. This questionnaire was completed in the home setting by caregivers and gave a global rating of infant and toddler temperament based on their behavior in a familiar environment. The ECBQ consists of 201 questions that form 18 scales that measure temperament factors such as high-intensity pleasure, sociability, and impulsivity. This questionnaire also includes 3 higher order factors: Negative Affectivity, Surgency Extraversion, and Effortful Control.

The 201 questions describe behavioral traits of the child as identified by the parents. The response options consist of a 7-point Likert-type scale that ranges from “never” to “always” and target conceptual aspects of temperament. The High-Intensity Pleasure scale consists of 12 questions and has properties that are consistent with the conceptual definition of novelty seeking (Rothbart et al., 2001); thus, it was the scale used in the current project. These questions assess a child’s willingness to engage in new situations and attitude toward these novel situations. Internal consistency for the High-Intensity Pleasure scale has a Cronbach’s alpha of .84 at 24 months of age and .88 at 36 months of age (Putnam et al., 2006). Test-retest reliability was .63 on the High-Intensity Pleasure scale at ages 24 and 30 months with a 6-month gap in testing (Putnam et al., 2006). Test-retest reliability was .72 on the High-Intensity Pleasure scale at ages 30 and 36 months with a 12-month gap in testing (Rothbart et al., 2001). Internal consistency was calculated for the present sample ($\alpha = .84$) and was commensurate with the internal

consistency found by Putnam and colleagues (2006; see Table 3).

Child Behavior Questionnaire (CBQ)

The CBQ (Rothbart et al., 2001) is a caregiver report measure used to determine global temperament ratings of children between the ages of 3-7 years. The present study utilized data from the CBQ that was administered at age 4. This questionnaire was filled out by caregivers and captured the child's temperament. There are 195 total items on the CBQ, which consists of 15 scales and 3 higher order factors (Rothbart et al., 2001). The 15 scales include temperament factors such as high intensity pleasure seeking, attention focusing, and approach, with most scales consisting of 12-13 items. This questionnaire is scored on a 6-point Likert-type scale (1= almost never to 6= almost always). The internal consistency coefficient, Cronbach's alpha, for the mean of all 15 temperament scales is .77 (Rothbart et al., 2001). Cronbach's alpha is .79 for the High-Intensity Pleasure scale, which consists of 13 questions, at ages 4 and 5 (Rothbart et al., 2001). The High-Intensity Pleasure scale has items consistent with the conceptual definition of novelty seeking and was used as a measure of novelty seeking for children at age 4 in the current study (see Appendix C for High-Intensity Pleasure scale items; Rothbart et al., 2001). Preschool novelty seeking was calculated using the mean of high intensity pleasure at ages 3 and 4, or high intensity pleasure at age 3 or 4 if one time point was not available. One measure of validity for the High-Intensity Pleasure scale was its correlation with the Extraversion/Surgency factor (0.76) for ages 4 and 5 (Rothbart et al., 2001). Internal consistency was calculated for the present sample ($\alpha = .71$) and was commensurate with the internal consistency found by Putnam and colleagues (2006; see Table 3).

Child Behavior Checklist (CBCL)

The school-age version of the CBCL (Achenbach & Rescorla, 2011) has a caregiver-, teacher-, and self-report measure used to assess psychological well-being and behavioral problems in school-age children ages 6-18 years (Achenbach & Rescorla, 2001). The CBCL was administered to children at age 5 in the SITSS sample and present study. The previous version of the CBCL (Achenbach, 1991) included children ages 5-18 and was administered to numerous families in the SITSS. To maintain consistency among the questionnaires between current and previous participants, current families were given the school-age CBCL (ages 6-18) which is most similar to the previous CBCL. The aggression scale is the same for the older 5- to 18-year-old version and newer 6- to 18-year-old version, although the rule-breaking scale has changed. However, Achenbach and Rescorla (2001) provide information on how to create the new scale for researchers who wish to use both versions in their study. The CBCL can be used in a clinical setting due to its syndromes and scales that are consistent with those found in the Diagnostic and Statistical Manual (DSM), such as Withdrawn/Depressed, Rule-Breaking Behavior, Aggressive Behavior, and Total Problems (Achenbach & Rescorla, 2001). The present study used a scale consistent with the DSM (i.e., rule-breaking; see Appendix D) but was scored according to clinical cutoff criteria because the current study did not include a clinical sample. Additionally, by using the raw data to describe rule-breaking I maximized the variability due to the non-clinical sample. This questionnaire assessed children's global behavior, both in the home and school setting.

The CBCL consists of 113 questions, creating 9 syndrome scales and 2 broad syndrome groups: Internalizing and Externalizing (Achenbach & Rescorla, 2001). The items on this questionnaire consist of a 3-point Likert-type scale, with 0= Not True and 2= Very True or Often

True. Higher scores on individual items indicate more problematic behavior as endorsed by parent report. The Aggressive Behavior scale consists of 18 items, and the Rule-Breaking Behavior scale consists of 17 items (e.g., breaks rules at home, school, or elsewhere, lying or cheating). However, there are several items on the Rule-Breaking scale that would be non-normative for preschool children (e.g., drinks alcohol without parent's approval); therefore, more items may be endorsed by parents for children at older ages. The present study included data from older children and adolescents, who may have been more likely to endorse these items. The Externalizing scale consists of items on both the Aggressive Behavior and Rule-Breaking Behaviors scales, and consists of those 35 combined items.

This test is both reliable and valid. Test-retest reliability was conducted on participants across a span of 8 days to compute a test-retest Pearson correlation score (Achenbach & Rescorla, 2001). Test-retest reliability scores were .91 for Rule-breaking behavior, .90 for Aggressive behavior, and .92 for Externalizing behavior (Achenbach & Rescorla, 2001). The mean test-retest reliability r for all empirically based syndrome scales on the CBCL was .90 (Achenbach & Rescorla, 2001). Construct validity was determined using CBCL scores correlated with scores on the DSM-IV Checklist. Rule-breaking behavior was correlated at .63 with Conduct problems, Aggressive Behavior was correlated at .64 with Oppositional Defiant Disorder, and Externalizing Behavior was correlated at .62 with Conduct problems in the DSM-IV Checklist (Achenbach & Rescorla, 2001). Cronbach's alpha was calculated for the present study as a measure of internal consistency. This study demonstrated lower internal consistency for the rule-breaking scale at age 5 ($\alpha = .54$) and at follow-up ($\alpha = .66$) than those reported by Achenbach and Rescorla in 2001 (see Table 3).

Behavioral coding

As part of SITSS testing at ages 1-5, both twins and one parent were filmed during a 10-minute parent child interaction activity in which the families are asked to complete a puzzle. Ten minutes was chosen for the SITSS sample as it is normally enough time to capture any disruptive behavior exhibited by the children, but ends before any significant frustration or extreme behaviors occur. These videotapes were later coded for a variety of behaviors by trained raters (Appendix E). One graduate student (myself) and several undergraduate students were trained in the behavioral coding scheme. Graduate students were asked to code at least 10 videotapes as a part of training. After these videotapes were coded, my thesis advisor, Dr. DiLalla, went over the videotapes to check for accuracy. Once coders obtained a 70% accuracy rate across all 20 behaviors, they were considered reliable able to code on their own. Reliability was assessed using weighted Cohen's kappa, which corrects for frequency of responses (Cohen, 1968). After they were deemed reliable to code independently, Dr. DiLalla conducted periodic checks to determine their continued reliability. It took approximately 2-4 months to train undergraduate students and 1 month to train graduate students with weekly meetings that reviewed the recordings and behavioral coding scores. Raters obtained a reliability score of at least .70 on each of the 18 codes during training before they were able to independently code videos

The coding scheme consisted of 11 parent behaviors and 7 child behaviors that were coded at one-minute intervals. At the end of each minute, the rater coded all 11 parent behaviors and 7 child behaviors before moving to the next minute. Each rater coded one child in the twin dyad to ensure that twins' scores remain independent and unbiased. For the present study, coded behaviors included number of minutes parent discipline was needed, as well as an aggregate

score of child's responsiveness to parent commands, child's cooperation with sibling, and number of aggressive incidents displayed by the child. Parent discipline was coded on a 4-point categorical scale that was then converted into a dichotomous variable to assess whether or not discipline was needed during each 1-minute interval. These scores were then summed across the 10-minute interaction to get a score that ranged from 0-10. All other behaviors were coded on 4-point scales, with 1 indicating that the behavior was present most of the minute, and 4 indicating the behavior was not present or rarely present. These scores were then averaged across the 10 minutes to get a score from 1-4 for each behavior. To create a single defiance score, the average scores for number of minutes discipline was needed, child's responsiveness to parent, child's cooperation with sibling, and number of aggressive incidents were z-scored and then averaged. Internal consistency for defiance in the present sample was acceptable ($\alpha = .73$) at age 5 (see Table 3). To determine whether this variable is in fact measuring defiance, I conducted a series of correlations for twin one and twin two separately to evaluate convergent validity. The defiance variable was correlated with negative emotionality (Bersted & DiLalla, 2016) at $r(91) = .22$, $p = .032$ for twin one and $r(92) = .92$, $p = .008$ for twin two. Additionally, the defiance variable was correlated with 5-year-old CBCL ratings of aggression at $r(93) = .30$, $p = .003$, rule-breaking at $r(93) = .26$, $p = .012$, and externalizing behavior at $r(93) = .30$, $p = .003$ for twin two, which provides some evidence for validity. This was a new variable and was not directly compared with a defiance measure per se. However, I referred to this variable as defiance for the present study because I believe that this term best captures these behaviors seen in the lab.

Zygoty

Zygoty was assessed on all same-sex twins using two methodologies. During testing, buccal cells were collected from both twins. During this process the caregiver wore gloves to ensure the purity of the sample. The caregiver then swabbed the inside of both children's cheeks for 20 seconds on each side and then places the samples in a container. This was completed 3 times throughout the testing session: before testing, before the parent-child interaction, and after testing. The samples were then placed into a freezer until they were sent off and analyzed at the VA Medical Center/Rhode Island Hospital under the supervision of Dr. John McGeary.

Additionally, zygoty was assessed using caregiver and greeter report of same-sex pairs of twins (opposite sex twin pairs were not assessed using this methodology as they are all DZ). Parents were mailed a packet that includes this questionnaire and they returned it at the time of the testing session (Appendix F). Research assistants (i.e., greeters) completed this questionnaire at the end of testing, after spending an hour interacting with the children in the waiting area. There were several items that assessed the similarity of physical characteristics (e.g., hair color, eye color) that were rated on a 5-point Likert-type scale (1= very similar, 5= not at all similar). Additional items on the parent version asked how often caregivers, friends, and relatives mix up the twins; items on the lab version asked for the degree of rater confusion. The scores on all of these questionnaires were used to determine whether twins are monozygotic or dizygotic.

Scoring on the first level assessed how similar the twins were on several physical characteristics. If the twins are dissimilar on these characteristics, the twins were rated as DZ. If twins were similar on this portion, the frequency that twins are mixed up by caregivers, friends, relatives, and research assistants was then assessed. Twins were classified as MZ on the first level if twins were similar on all characteristics and were often confused by others. Zygoty is

then further assessed using subsequent scoring levels if twins could not be classified as MZ on the first level. The SITSS sample has a 96% accuracy rate using these questionnaires when compared with genetic testing. Zygosity was assessed using these questionnaires for all same-sex twin pairs in the current sample.

Procedure

Participants were initially recruited to the study at ages 1-5 years using referrals, birth announcements, a SITSS Facebook page, and advertisements through local community agencies. The Graduate Assistant (GA) lab coordinator from the SITSS study contacted participants via telephone if they expressed a desire to participate. If participants were interested in completing the study, the GA set up an appointment within one month of their birthday at the SITSS laboratory at SIUC. Approximately one week before their testing appointment, the GA sent out a testing packet for caregivers to complete and return during their scheduled testing period. The testing packet consisted of several informational sheets on the SITSS study, directions to the testing site, and questionnaires specific to the child's age (e.g., consent form, daycare information, temperament questionnaires, CBCL).

Upon arriving at the SITSS lab for testing, one undergraduate assistant greeted the family in the parking lot and brought them to the laboratory. The tester, who was a graduate student, then collected the family's paperwork and ensured it was completed. I was one of the testers and thus have tested a small portion of the families. The GA went over all consent forms and gave the parent a copy of the testing consent form, as well as the video and buccal cell consent forms. The GA had the parent collect buccal cells from both twins before beginning testing if buccal cell samples had not been collected from two earlier ages. After ensuring that the paperwork was finished, the GA took one child back to the testing room to complete a battery of tests that

assessed developmental social and cognitive skills while an undergraduate assistant video-recorded this test. The GA then took the child back to the waiting area and completed the testing battery with the other twin. Once both twins had been tested, the GA returned both twins to the waiting area and had the parents collect buccal cells from the children a second time.

After these were collected, the GA directed both children and one parent to the interaction room where the researcher instructed the parent to assist both of their children in the completion of two puzzles for 10 minutes. All puzzles were chosen based on the age of the children. The 5-year-olds were given one puzzle to shape by categories (e.g., a cultural identity and its respective identifiers) and a second, traditional puzzle. An undergraduate assistant videotaped this interaction. After the interaction was completed, the GA took the family back to the waiting area to have the parents collect buccal cells from both children for the final time. The graduate tester took a picture of both children and gave them each toys that approximate \$10 in value. If the children were 5 years old, the parents also completed an invoice and received a \$50 check in the mail.

Follow-up testing

Most follow-up data were collected from three previous studies associated with SITSS. I conducted an additional follow-up study to collect additional CBCL questionnaires. The first follow-up study (2002-2004) had participants that ranged in age from 10-13 years old. Potential participants were mailed a questionnaire that assessed their interest in the follow-up study. If parents were interested they were mailed a few questionnaires, including the CBCL, with a pre-stamped return envelope. Participants were compensated with \$10 gift cards for the completion of the study.

Researchers from the second study (EGO; tested in years 2009-2010) contacted previous

SITSS participants who were aged 6-16 years using a recruitment letter to assess their interest in completing a follow-up study. If interested, participants returned a pre-stamped envelope and form, and they were contacted via telephone to set up an appointment for testing. All questionnaires, including the CBCL, were completed in the lab during testing. The assessment session consisted of an eye-tracking test and buccal cell collection. All participants were compensated with a \$25 gift card for parents, \$30 gift card per child, and approximately \$10 worth of toys.

Researchers from the third study (Emotion; 2012-2013) contacted previous SITSS participants who were between the ages of 6-10 years old. Potential participants were mailed a recruitment letter with a pre-stamped envelope and form that was to be returned if they were interested. Participants who responded were then contacted via telephone to set up an appointment. Participants completed all questionnaires, including the CBCL, in the lab during testing. Upon arrival, graduate assistants completed the consent and assent with the families and performed a variety of cognitive and emotional tasks with the children while the parents completed the questionnaires. Families were compensated \$50 for completion of this study, as well as approximately \$10 worth of toys per child. The questionnaires from all assessments were kept in a locked filing cabinet in the SITSS laboratory.

I sent an email (Appendix G) to families who had previously completed testing for the SITSS lab to identify individuals who are interested. All participants aged 6-16 who had not previously participated in a follow-up study were recruited. I contacted 86 potential participants through mail or email. If the parents were interested, I mailed the participants a consent form (Appendix H) and CBCL questionnaire with a pre-addressed return envelope. Of these participants, 22 requested that a packet be mailed and 14 returned these packets. There were 8

participants who did not return their packets despite at least 2 follow-up emails and 2 follow-up phone calls. Of the 14 returned packets, all participants whose parents agreed to complete this study and filled out paperwork were aged 6-8. I used a lottery method and raffled off a \$25 Amazon e-giftcard to one family for their completion of a follow-up parent-report CBCL.

Power Analyses

Before beginning my project, I ran a power analysis using G*Power to determine the appropriate number of participants. For this power analysis I used the most conservative estimate for the most complex analysis that my hypotheses would require. This analysis included a linear regression with one dependent variable, three independent variables, including an interaction variable, and two possible covariates. To detect a small effect size (.2) with an alpha level of 0.05, I needed approximately 105 participants. To detect a medium effect size (.5) with an alpha level of 0.05 I needed approximately 46 participants.

CHAPTER 4

RESULTS

For the present study I used IBM SPSS Statistics version 24 to organize and analyze all of my data. Prior to conducting analyses, all data were double entered by two undergraduate research assistants. My primary advisor and I cleaned all data sets used in the present study to identify and correct any entry errors. Before analyses were conducted, the data were examined for normality and to identify any outliers (see Table 4). Defiance, rule-breaking at age 5, and rule-breaking at follow-up were all positively skewed; thus, I used the square root of each of these variables to normalize the data. I attempted to normalize the Defiance variable, but was unable to do so; therefore, I used the square root of this variable to reduce some of the skewness. Novelty seeking (i.e., high-intensity pleasure) at ages 3 and 4 were both negatively skewed; therefore, the variables were squared to normalize the data. A one-way ANOVA was conducted on follow-up scores of rule-breaking to examine any differences on mean scores of rule-breaking between the four follow-up cohorts (i.e., initial follow-up, EGO Study, Emotion Study, and current follow-up). These results were non-significant, $F = 2.42$, $p = .069$, indicating no significant differences between follow-up groups. One twin from each pair was selected for Hypothesis 1 to ensure that family effects did not skew the results of these analyses, because having more than one child from a family would have violated the independence of sample assumption. To do this I randomly chose one twin to analyze for each sub-hypothesis before conducting the analyses or reviewing the results. Analyses for Hypotheses 2 and 3 included both twin type and family effects; therefore, the entire sample was used in these analyses. The sample size varies per hypothesis because not all data were available for all children in the study.

Hypothesis 1: Stability of Constructs

I evaluated the developmental trajectory and stability of both novelty seeking and rule-breaking beginning in preschool and continuing through early adolescence. To analyze this hypothesis I randomly selected one twin from each family to ensure that family effects did not violate the independence of sample

Hypothesis 1A: Novelty seeking stability

Hypothesis 1A predicted that novelty seeking would remain stable from ages 3 to 4. I ran a bivariate correlation to measure the relationship between novelty seeking at ages 3 and 4. There was a significant positive correlation of moderate strength, $r(74) = 0.38$, $p = .001$, between novelty seeking at ages 3 and 4 (see Table 5).

Since the correlation between novelty seeking at ages 3 and 4 was moderate, I ran a paired samples t-test to determine if there were significant differences between these two groups and to evaluate the trajectory of novelty seeking at these two time points. In this t-test, novelty seeking at age 3 was compared to novelty seeking at age 4. Scores on the paired samples t-test (see Table 6) indicated a significant difference between novelty seeking at age 3 ($M = 26.51$, $SD = 8.78$) and novelty seeking at age 4 ($M = 30.07$, $SD = 11.12$). This difference was significant, $t(75) = -2.80$, $p = .007$, and represented a small effect size, $d = -1.45$ (Field, 2013).

Approximately 47.1% of children increased in their level of novelty seeking between age 3 and age 4; 52.9% of children decreased in their level of novelty seeking between these two time points. The mean difference between the two time points was calculated ($M = 0.03$, $SD = 1.11$), and 28% of children had a mean difference score beyond one standard deviation. Thus, this hypothesis was partially supported as a relationship was found between the variables, although novelty seeking did significantly increase across the two time points.

Hypothesis 1B: Rule-Breaking Stability

Hypothesis 1B stated that early caregiver ratings of rule-breaking would be related to caregiver ratings at follow-up, ages 6-16. To examine this hypothesis I ran a bivariate correlation on one randomly selected twin from each twin pair ($N=107$). Results demonstrated a strong positive relationship, $r(105) = 0.50, p < .001$, between 5-year-old ratings of rule-breaking and follow-up ratings of rule-breaking (see Table 5). I ran a repeated-measures ANOVA to determine the presence of significant differences between the group means at the two time points with rule-breaking as the dependent variable, age at follow up as the within subjects variable, and sex as the between subjects variable (see Table 7). Scores on the repeated measures ANOVA indicated no significant differences between rule-breaking at age 5 and follow-up (ages 6-16), $F(1, 104) = .003, p = .955$, and no significant effects of sex or length of time between the two ages.

As another way to assess rule-breaking, I used coded ratings obtained during the parent-child interaction at age 5 to create a defiance construct. I then used this construct to further evaluate Hypothesis 1B. Bivariate correlations were used to assess the relationship between measures of defiance at age 5 and caregiver ratings of rule-breaking at ages 5 and follow-up. Rule-breaking at 5 years old and defiance at 5 years old, $r(94) = .12, p = .254$, and rule-breaking at follow-up and defiance at 5 years old, $r(57) = .01, p = .932$, were not significantly correlated (see Table 5).

Overall, this hypothesis was partially supported. Caregiver ratings of rule-breaking at age 5 and follow-up demonstrated a positive relationship between the two time points and no significant differences in these two points. Novelty seeking demonstrated a positive relationship at the two time points, but increased from age 3 to age 4. Further, observed defiance was not

correlated with parent-rated rule-breaking at either time point.

Hypothesis 2: Heritability of Novelty Seeking, Rule-Breaking, and Defiance

Hypothesis 2 stated that there would be a genetic component to novelty seeking, rule-breaking, and defiance. The data file was first split into MZ and DZ twins. Since MZ twins share approximately 100% of their DNA and DZ twins share approximately 50% of their DNA, this allowed me to estimate the heritability of these three behaviors (DiLalla et al., 2009). A reliability analysis was conducted to determine the intraclass correlation coefficient (ICC) using a one-way random model. This was done separately for MZs and DZs. Then I used the Fisher's r -to- z transformation to determine if the difference between ICC for r_{MZ} and r_{DZ} was significant. Heritability was calculated using Falconer's estimate of heritability [$h^2 = 2(r_{MZ} - r_{DZ})$] where r_{MZ} was the ICC for MZ twins and r_{DZ} was the ICC for DZ twins. Then, r_{MZ} was subtracted from r_{DZ} and multiplied by 2 to get an estimate of heritability. If r_{MZ} was more than twice r_{DZ} , or if the ICC for DZ twins was negative, then r_{MZ} was used as the best estimate of heritability as this may suggest nonadditive or dominant genetic components since heritability estimates cannot exceed r_{MZ} . These scores were calculated separately for each construct at each age.

Since r_{MZ} is more than double r_{DZ} for estimates of novelty seeking at ages 3 and 4, this suggested non-additive genetic components or dominance; thus, heritability was calculated using the MZ twin estimate (see Table 8). Novelty seeking at age 3 ($N = 36$ MZ, 56 DZ) and age 4 ($N = 38$ MZ, 81 DZ) both demonstrated high levels of heritability, $h^2 = .75$ and $h^2 = .62$, respectively. Similarly, defiance at age 5 ($N = 34$ MZ, 63 DZ) demonstrated high heritability, $h^2 = .75$. Parent reports of rule-breaking at follow-up (ages 6-16) also demonstrated high heritability ($N = 40$ MZ, 83 DZ), $h^2 = .68$. Parent reports of rule-breaking at age 5 demonstrated the lowest estimates of heritability ($N = 81$ MZ, 154 DZ) of all constructs, $h^2 = .40$, although it still reached significance.

Hypothesis 3: Using Novelty Seeking and Defiance to Predict Rule-Breaking

For the third hypothesis, I evaluated the relationship between novelty seeking and rule-breaking. Earlier novelty seeking and defiance seen during the 10-minute parent-child interaction were used as predictors for rule-breaking. I hypothesized first that preschool novelty seeking and defiance would predict rule-breaking at age 5 and rule-breaking at follow-up. Additionally, I hypothesized that there would be a significant interaction between levels of novelty seeking and defiance as they impact caregiver ratings of rule-breaking. Specifically, children who displayed high levels of preschool novelty seeking and demonstrated more defiance during the parent-child interaction at age 5 would have the highest scores on caregiver ratings of rule-breaking at ages 5 and follow-up.

To test the relationship between these variables, two multilevel linear models were used to predict parent reports of rule-breaking at both time points from preschool novelty seeking and five-year-old defiance. The use of multilevel analyses allowed the slopes and intercepts to differ across families, which helped to determine the within-family effects on rule-breaking. Based on a strong reliability coefficient for age 3 and age 4 high intensity pleasure items, an averaged score of novelty seeking (i.e., preschool novelty seeking) from both ages was used as an independent variable in these analyses. To determine the best fitting model, I used the model with the lowest Hurvich and Tsai's criterion, which is a goodness-of-fit measure designed for small samples (Field, 2013).

Tables 9-12 present all model fitting results. The first regression model (see Table 9) included rule-breaking at age 5 as a dependent variable, and sex, preschool novelty seeking, and defiance at age 5 as fixed factors. This model was used as a baseline against which the other models were compared. The second model added family as a random effect (Model 2). This

model fit the data significantly better than the first model. The third model added novelty seeking and defiance as two random slopes in the equation, which did not result in a significantly better fit. As the random slopes did not significantly improve the fit of model three, these slopes were not included in model four. The fourth model included the interaction between preschool novelty seeking and defiance at age 5 as a predictor. This model did not significantly increase the fit of the model. Therefore, the model including the family effects, with novelty seeking and defiance as fixed intercepts, was the best fitting model (Model 2). When evaluating this model more closely, the family as a random effect was the only significant predictor variable (see Table 10).

The second regression model (see Table 11) included rule-breaking at follow-up (ages 6-16) as the dependent variable and sex, age at follow-up, preschool novelty seeking, rule-breaking at age 5, and defiance at age 5 as fixed factors. This model was used as a baseline against which the other models were compared. The second model added family as a random effect (Model 2). This model had the lowest corrected Akaike Information Criterion(AICC), but did not provide a significantly better fit than the first model. However, as the second model includes the family effects on scores of follow-up rule-breaking, this model was preferred to Model 1. The third model added defiance as a random slope in the equation, which did not result in a significantly better fit. No other random slopes were added to this model as the lack of variability among these constructs created a Hessian Matrix error and thus distorted potential results. As the random slopes did not improve the fit significantly, these were not included in the fourth model. The fourth model included the interaction between preschool novelty seeking and defiance at age 5 as a predictor, which did not result in a significantly better fit. Therefore, the model including the family as a random effect was the best fitting model (Model 2). When evaluating this model

more closely, rule-breaking at age 5 and defiance at age 5 as fixed effects significantly predicted rule-breaking at follow-up (see Table 12).

Post-hoc exploration of novelty seeking and rule-breaking

As some rule-breaking items may not be frequently endorsed in younger children due to their developmental relevance (e.g., sex problems) and novelty seeking may pertain to specific sub-behaviors present in rule-breaking, I also correlated novelty seeking with each of the CBCL rule-breaking items (see Table 13). At age 5, “sets fires” was the only rule-breaking item significantly correlated with novelty seeking $r(216) = .14, p = .040$. At follow-up, “swearing” was the only item that was significantly correlated with novelty seeking in young childhood, $r(105) = .23, p = .018$. Correlations could not be calculated for several items at both time points due to lack of variability with specific questions. Overall, most items on the rule-breaking measure did not demonstrate a significant relationship with novelty seeking.

CHAPTER 5

DISCUSSION

The primary goal of this study was to evaluate the stability and heritability of novelty seeking, rule-breaking, and defiance in early childhood, late childhood, and early adolescence. Further, I hoped to determine how these constructs relate to each other and predict later rule-breaking behavior in late childhood and early adolescence. Rule-breaking at ages 5 and follow-up (6-16), novelty seeking at ages 3 and 4, and defiance at age 5 all demonstrated significant heritability. Rule-breaking demonstrated significant stability between age 5 and follow-up (6-16). Finally, defiance as observed in the laboratory and rule-breaking at age 5 significantly predicted later rule-breaking.

Novelty Seeking

Researchers have found that both novelty seeking and rule-breaking follow a specific trajectory that does not remain stable throughout development (Fite et al., 2012; McCabe et al., 2015). However, there is little research evaluating the development of these constructs in early childhood (i.e., preschool). Therefore, it is possible that these are more stable constructs that have not been evaluated in this young age group. Results suggest that there was a moderate relationship between novelty seeking at age 3 and age 4, although rates of novelty seeking were significantly increased at age 4. Rates of novelty seeking were significantly different, but the effects of this difference were small and should be taken into account when interpreting the results. The relationship between these scores may indicate that novelty seeking is an innate temperamental characteristic that persists throughout early development. Although this may be a fairly stable personality trait, it is possible that the environment may mediate its expression. It is interesting to note that scores increased as the children got older, which may have several

potential causes and implications. Higher rates of novelty seeking at age 4 may be due to increased choice and autonomy in children's environment that allows children to demonstrate increased novelty seeking. This is fairly consistent with findings that one's environment partially dictates which traits are expressed throughout the life span, wherein more environmental choice leads to higher genetic expression (Burt et al., 2016; Plomin et al., 2013). Results such as this suggest the relative importance of environmental factors throughout the life span.

Further, it is possible that differences in scores of novelty seeking may be due to observer bias or measurement error. Although observer reports are frequently used to measure children's behaviors, researchers have consistently found that raters are not always the most valid or reliable reporters of behavior (Laird & LaFleur, 2014). Further, parent characteristics (e.g., psychopathology) may differentially influence parent interpretation of child behavior (Kroes, Veerman, & De Bruyn, 2003). Similarly, it is possible that these measures evaluated environmental situations instead of intrinsic temperament characteristics (McCrary, 2015). Another potential variable in this study was the use of two equivalent forms to evaluate novelty seeking at different ages. It is possible that the construct remained the same, but the questions on the two questionnaires were assessing different components of novelty seeking or that the questions evoked slightly different responses. Although there was a significant relationship between novelty seeking at the two times points and rule-breaking at the two times points, these correlations were modest indicating that behavior is fluid and changes throughout time.

Rule-Breaking

There was a significant relationship between rule-breaking at age 5 and at follow-up (ages 6-16). There were no significant differences in the amount of rule-breaking seen throughout early development. It should be noted that this was not a clinical sample and most

children demonstrated relatively low rates of rule-breaking at both time points. There were no girls who demonstrated clinically significant levels of rule-breaking at age 5 and only two girls who demonstrated clinically significant levels of rule-breaking at follow-up. There were only two boys who demonstrated clinically significant levels of rule-breaking at age 5 and four boys who demonstrated clinically significant levels of rule-breaking at follow-up. It is also possible that many items on the rule-breaking scale were not relevant for typically developing young children and early adolescents (e.g., vandalism, sex problems).

It is important to note that there was relatively little change in rule-breaking behavior throughout childhood and adolescence. This is important as it corroborates findings that children do not grow out of externalizing problem behaviors (McNeil, Capage, Bahl, & Blanc, 1999). Similarly, it is important to recognize that some rule-breaking behaviors may not be normative behavior influenced solely by external influences such as peer pressure. Consistent with this, researchers have found that disruptive behavior in childhood tends to be stable and requires early intervention to improve positive outcomes (McNeil et al., 1999). Therefore, it may be important for adults in positions of authority to take notice if children and adolescents begin to repeatedly break the rules either at home or at school.

The present results suggest that defiance at age 5 and rule-breaking at age 5 are unrelated constructs. This may indicate that the behaviors seen in the laboratory observation are different than the behaviors seen by parents at home. In addition to capturing different behaviors, it may indicate that objective observers and parents have different perceptions of normative and problematic behavior or observe different behaviors based on environmental conditions (Petitclerc et al., 2015). Although these behaviors are not correlated at age 5, this does not preclude defiance as a potential contributor for later externalizing behavior. Defiance did indeed

predict follow-up rule-breaking in this study. Another possibility is that some defiance is a normative part of child development or that it may be related to other forms of externalizing pathology in childhood. It may be the case that low levels of defiance are a normative part of child development as this construct demonstrated the lowest amount of variability when compared to novelty seeking and rule-breaking. In this case, some defiant behavior in early childhood may be seen as a developmental milestone, as opposed to a precursor to externalizing psychopathology. However, high levels of defiance may indicate the presence of some risk factors for later rule-breaking, as will be discussed in further detail next.

Novelty Seeking, Defiance, and Rule-Breaking

The last hypothesis posited that novelty seeking and defiance in early childhood would predict 5-year-old rule-breaking and rule-breaking at follow-up (ages 6-16). There was a significant family effect on 5-year-old rule-breaking, indicating that families significantly differed in their level of rule-breaking. Neither 5-year-old defiance nor preschool novelty seeking significantly predicted 5-year-old rule-breaking. Therefore, novelty seeking was not associated with rule-breaking at either time point in the present study. This is in contrast to previous studies that have found a relationship between the two constructs (Jensen et al., 2011). It may be more likely that novelty seeking does not serve as a risk factor for later rule-breaking per se. Researchers from one study found that novelty seeking, when combined with sociability (e.g., high peer interaction) and extraversion, were likely to lead to negative outcomes later in life (Dick et al., 2013). The present study assessed for an interaction between novelty seeking and defiance, but did not find any significant interaction. Therefore increased defiance and novelty seeking together do not appear to influence rates of rule-breaking. It may be that other factors (e.g., low parental supervision, negative peer influences) when combined with novelty

seeking may lead to higher levels of rule-breaking.

Furthermore, rule-breaking at age 5 and defiance at age 5 both significantly predicted rule-breaking at follow-up. This is an important finding as these two variables predicted rule-breaking at follow-up. Therefore, parent reports at age 5 are likely a good estimate of later behavior and may serve to identify early risk factors. In fact, despite the relatively low levels of rule-breaking in this sample, this behavior remained fairly consistent between these two age ranges even when measured across longer time frames.

Further, laboratory based behaviors as measured by an objective reporter also served to identify later risk factors. It is interesting to note that defiance at age 5 per se was not correlated with rule-breaking at either age and did not significantly predict rule-breaking at age 5. Yet, defiance at age 5 did predict rule-breaking at follow-up when taking into account variance due to individual families. Therefore, defiance seen in the laboratory session may measure behavior that is likely to become problematic at a later age. It is important to identify developmentally appropriate behaviors that may serve as early risk factors and contribute to later disruptive behaviors. This is important as many problematic behaviors may not be seen in early childhood based on developmental age (e.g., sex problems) and others may be unlikely based on physical development (e.g., forcible theft; Wakschlag et al., 2007). However, pervasive and persistent defiance in young children may be a valuable tool for assessing later disruptive behavior (Wakschlag et al., 2007). This is consistent with the results from this study, which indicated that observer reports of preschool defiance during parent-child interactions predicted rule-breaking behavior at follow-up.

Therefore, if a child displays high levels of defiance as noted by observer reports and high rule-breaking in early childhood, it may be necessary to engage this child in proactive or

preventative programs to decrease their risk of future rule-breaking. Further, it appears that both defiance and early rule-breaking may contribute to rule-breaking in late childhood and early adolescence. In this case, it is important for researchers to determine how these behaviors individually affect later rule-breaking to further identify risk factors. This will help to inform prevention and intervention efforts in young children.

Heritability

Heritability may play a role in behavioral predispositions. Results indicated that novelty seeking at ages 3 and 4 were both significantly heritable. Buss and Plomin (1984) found consistent results, indicating that these early personality traits (i.e., temperament) are highly heritable (as cited in Plomin et al., 2013). Other researchers have found strong heritability in parent-rated reports of temperament, similar to the questionnaires used for the current study (Saudino, 2005). Further, parent reports of temperament often demonstrate low rates of DZ correlations, equal to, or below, zero, which may be influenced by parents' tendencies to overstate differences between co-twins (Saudino, 2005). Results for the current study found comparable results indicating that parent bias may play a role in the estimation of heritability among twin pairs. In the present study, I demonstrated significant heritability of early novelty seeking, although we must consider potential rater biases.

Estimates of heritability were also significant among parent-reported rule-breaking scores in early childhood through adolescence. This is consistent with research suggesting a genetic component to non-aggressive disruptive behavior problems (Burt et al., 2016). Although MZ correlation rates were the largest for 5-year-old rule-breaking, this age demonstrated the lowest heritability due to high DZ correlation rates. This indicates that shared and non-shared environment may play an important role in rule-breaking during early childhood. In contrast,

heritability played a larger role in rule-breaking during follow-up (ages 6-16). Researchers have consistently found some behaviors demonstrate higher heritability when individuals are given more choice and freedom to express their genetic material (Burt et al, 2016; Plomin et al., 2013). If the proportion of some contributors to behavior increase (e.g., genetics and nonshared environment), the proportion of the other contributors (e.g., shared environment) may decrease. Therefore, it is possible that the salience of certain environmental or genetic factors at different time points may differentially affect the expression of behavior. One potential explanation is that these children demonstrated higher levels of heritability for rule-breaking when there was less restriction in their environment. Further, this may indicate that environmental factors influence the amount of genetic potential that is likely to be expressed, but heritability may play a bigger role in adolescence.

Defiance viewed during the parent-child interaction demonstrated high levels of heritability. This is an important finding as this was the only construct measured by observer report and not parent report. Few studies have used objective observer reports as a measure of heritability in young children. However, researchers from one study found that both parent report and observer report of 5-year-old children's antisocial behavior were reliable and unbiased (Arseneault et al., 2003). This indicates that laboratory measured behavior may provide important information about children's disruptive behaviors that may be used in collaboration with parent reports. Further, the disruptive behaviors seen among children appear to be heritable when measured by multiple sources.

Overall, temperament at both ages 3 and 4 demonstrated high heritability. It is important to bear in mind that high MZ correlations and low DZ correlations may be influenced by rater bias. Further, rule-breaking appears to be influenced largely by environmental influences in

early childhood. Yet, heritability was higher during adolescence, indicating that genes may play a greater role at older ages. Finally, defiance demonstrated high levels of heritability. This is an important finding as this is the only construct that was measured by observer report.

Strengths

There were numerous strengths present in the current study. One strength of the present study is the use of longitudinal data to determine the stability of these behaviors over an extended period of time. Many studies are only able to follow participants several months to one year past their initial data collection, so the ability to measure participants several years after their 5-year-old testing session meaningfully contributes to the literature in this area. This is exceptionally important as many people have the belief that disruptive behaviors may be common throughout child development depending on environmental circumstance. The results from this study indicate that this is not the case, as most participants demonstrated low levels of rule-breaking at both time points. Further, as this was a community sample, it was important to determine how early childhood behaviors may influence later disruptive behaviors and cause impairment. This is important as many children may exhibit sub-threshold symptoms before seeking treatment for more extreme disruptive behaviors later in life. Therefore, the present study was a meaningful contribution to normative development in early childhood and potential risk factors that may influence later psychopathology.

Another strength of the present study was the use of the twin design. This design allowed me to determine the heritability of these behaviors at different points in the life span. This is an important component to the study, as it shed more light on which constructs likely have a strong genetic component and which of these behaviors may be more influenced by environmental factors. This is important as it may impact the types of treatment that are provided and provide

information on the aspects of child behavior that are likely more susceptible to environmental influence. Further, heritability changes throughout the life span (Plomin et al., 2013); thus, it is important to measure these behaviors during different developmental points. In fact, rule-breaking demonstrated more susceptibility to environmental factors early in life, indicating that this may be an optimal time for intervention. Another benefit of using the twin design was to account for the effect of the family on rule-breaking. As the models suggested that there is a significant family effect of rule-breaking, interventions may be better tailored to specific families instead of a particular child in each family.

Finally, a major strength for the present study is the use of both parent report and observer report of child behavior. This is important as different reporters may be capturing different aspects of behavior that serve as risk factors for later rule-breaking. As many parent reports of behavior contain some bias, it is important to determine whether an observer may be able to provide a meaningful measure of child behavior that may identify later risk.

Limitations

One weakness of the present study is that the majority of the children in the sample were European American families from a sample in the rural Midwest. Further, most of the families demonstrated low levels of disruptive behaviors and there was little variability with respect to these behaviors. Therefore, it is unlikely that the same risk factors apply to urban populations or minority youth. Further, it is possible that clinical samples may demonstrate different risk factors that may influence the development of rule-breaking in late childhood and adolescence. Additionally, we did not obtain information on psychological treatment or stressful life events that occurred in the current sample. Therefore, it is possible that some children may have demonstrated sub-threshold or significant symptoms, but received interventions and thus had

lower rates of follow-up rule-breaking.

Another limitation of the current study is the use of two different forms to measure novelty seeking at age 3 and age 4. Although the forms used are equivalent forms, the minor differences in question presentation may have impacted the stability of novelty seeking between these two ages. It would have been beneficial to include a measure of novelty seeking at follow-up to determine the stability of this trait during different developmental periods. Additionally, due to the low levels of DZ correlations on preschool novelty seeking that may be partly due to reporter bias, it would have been preferable to have an objective observation of novelty seeking during this age group. Further, it is unclear at the present time whether the defiance observation variable measures defiance *per se*. It did demonstrate some convergent validity with other measures and was predictive of future rule-breaking, which demonstrates significant promise. Finally, it is possible that novelty seeking may be associated with positive prosocial behaviors (e.g., introducing yourself to a new classmate); however, the present study did not evaluate the relationship between novelty seeking and prosocial behaviors.

Future Directions

Although this study makes a meaningful contribution to the current literature, it is important to note that there are several ways to extend upon these findings. One future direction is to determine whether novelty seeking, rule-breaking, and defiance are present in different populations. It may be important to determine whether high levels of defiance and early rule-breaking serve as potential risk factors for later rule-breaking in different populations. Further, it is important to determine whether early intervention for children who demonstrate high levels of rule-breaking and defiance significantly improves outcomes in late childhood and early adolescents. As the only measure of defiance used a new variable, this variable should be

measured against another measure to determine whether it is measuring defiance per se. The present results indicate that both heritability and environment play a significant role in the development of rule-breaking, but this study did not evaluate the specific environmental factors that may contribute to its etiology. As family factors significantly affected rates of rule-breaking at both age 5 and follow-up, researchers may benefit from evaluating variables such as parent characteristics which may contribute to discipline and child behavior. Therefore, it may be important to identify specific environmental factors that interact with genetic risk factors to produce poor outcomes.

Further, this article was written from the point of view of a deficit model. In addition to identifying risk factors, it is of equal importance to identify protective factors and normative behaviors that may contribute to positive outcomes. As stated earlier, it may be important to consider whether novelty seeking may contribute to the development of prosocial behaviors. Therefore, future researchers may benefit from evaluating environmental factors that may moderate the influence of early defiance or early rule-breaking. By identifying potential protective factors, agencies may be able to provide environmental variables that will increase positive youth development.

Clinical Implications

This study found differences between novelty seeking at age 3 and age 4 as measured by two distinct forms. Clinicians commonly use parent report forms to capture behavior relevant for treatment planning and evaluation. It is important to note that although forms may purport to measure similar constructs, equivalent forms may produce different results. This may be due to a variety of factors, such as reporter bias and the measurement of trait versus state characteristics (Laird & LaFleur, 2014; McCrary, 2015). This variability should be taken into consideration

when these questionnaires are distributed to aid with treatment planning or used for diagnostic utility. It is important to include multiple reports and observations whenever possible to get a global assessment of child functioning.

Another important clinical implication is that rule-breaking remains stable from early childhood through adolescence. This is important because it corroborates research that disruptive behaviors are often pervasive and require therapeutic intervention (McNeil et al., 1999). Although most children in the sample demonstrated low rates of rule-breaking, it is important to emphasize that rates of rule-breaking did not increase significantly between age 5 and follow-up. Therefore, it is unlikely that all rule-breaking behaviors are subclinical and indicative of normative development. Additionally, rates of defiance were significantly linked with follow-up rule-breaking. Although both rule-breaking and defiance significantly predicted rule-breaking at follow-up, the two different behaviors predicted follow-up behavior. Thus, both defiance and rule-breaking may play a significant role in later disruptive behavior disorders that may require intervention.

Finally, heritability estimates indicate that all of these behaviors include both genetic and environmental contributions. Therefore, the environment plays a role in the development of later rule-breaking behavior. Further, different behaviors demonstrated different estimates of heritability, which may indicate which behaviors may be more susceptible to environmental manipulation. For example, 5-year-old rates of rule-breaking demonstrated the lowest estimates of genetic influence and the highest estimates of environmental influence. Therefore, it may be necessary to provide intervention earlier in life when the relative impact of the environment may be more likely to alter behavior significantly.

Conclusion

The present study evaluated the stability of preschool novelty seeking and childhood and adolescent rule-breaking. Results indicated that 3-year-old and 4-year-old novelty seeking were correlated, although there were significant differences between these two age groups. It is possible that reporter bias may have played a role in rates of preschool novelty seeking. Further, rule-breaking demonstrated significant stability from age 5 to follow-up. This indicates that rule-breaking behaviors are likely to remain fairly stable throughout childhood and adolescence.

Novelty seeking, rule-breaking, and defiance in early childhood all demonstrated a significant heritable component, although the environment was also an important factor for these behaviors. Finally, there was no relationship between preschool novelty seeking and 5-year-old or follow-up rule-breaking. However, 5-year-old rule-breaking and defiance predicted rule-breaking at follow-up (ages 6-16) indicating that both parent and observer report may be used to identify children at risk for later disruptive behavior problems. It may be important to identify children who demonstrate high rates of rule-breaking and defiance in early childhood and provide them with appropriate interventions in an effort to decrease later rule-breaking behavior.

Table 1

Description of Current Sample in Comparison to Total SITSS Sample

	N	Age mean	Age SD
SITSS Sample	733	-	-
Number of participants from SITSS sample in current study	592	-	-
Children in follow-up	252	8.43	2.08

Note: The total N represents the number of children who have family information for the SITSS study at any age.

Table 2

Family Information for Current Sample

Variable	Minimum	Maximum	Median
Mother's Education	1	5	4
Mother's Occupation	1	7	4
Father's Education	1	8	4
Father's Occupation	1	9	4
Income	1	19	12

Note: Maternal/paternal occupation (1= unskilled laborer to 7 high level professional); maternal/paternal education (1= some high school to 7 advanced training beyond college degree); income (1= less than \$5,000 to 19= over \$90,000).

Table 3

Cronbach's Alpha for all Measures in Standardization Samples and SITTS Sample

Factors	SITSS Sample	Standardization Sample
ECBQ Novelty Seeking Age 3	.84	.88 ^a
CBQ Novelty Seeking Age 4	.71	.79 ^b
Preschool Novelty Seeking Mean	.85	N/A
CBCL Rule-Breaking Age 5	.54	.85 ^c
CBCL Rule-Breaking Follow-Up	.66	.85 ^c
Observed Defiance Age 5	.73	N/A

^a Putnam, S. P., Gartstein, M. A., & Rothbart, M. K. (2006). Measurement of fine-grained aspects of toddler temperament: The Early Childhood Behavior Questionnaire. *Infant Behavior and Development*, 29(3), 386–401. <http://doi.org/10.1016/j.infbeh.2006.01.004>

^b Rothbart, M. K., Ahadi, S. A., Hershe, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development*, 72(5), 1394-1408.

^c Achenbach, T. M., & Rescorla, L. A. (2001). Manual for the ASEBA school-age forms & profiles. Burlington, VT: University Vermont, Research Center for Children, Youth, & Families.

Table 4

Normality Statistics for Novelty Seeking at Ages 3 and 4, Rule-Breaking at Age 5 and Follow-up, and Observed Defiance at Age 5

Factor	N	Mean	SD	Uncorrected		Corrected	
				Skewness	Skewness SE	Skewness	Skewness
				Statistic		Statistic	SE
ECBQ Novelty Seeking Age 3	214	5.07	.93	-.52	.17	.09	.17
CBQ Novelty Seeking Age 4	249	5.44	1.04	-.54	.15	-.13	.15
CBCL Rule-Breaking Age 5	482	1.50	1.73	1.86	.11	.18	.11
CBCL Rule-Breaking Follow-Up	253	1.50	1.89	1.97	.15	.38	.15
Observed Defiance Age 5	199	-.01	.75	1.70	.17	1.38	.17

Table 5

Hypothesis 1: Correlation Matrix for Novelty Seeking at Ages 3 and 4, Rule-Breaking at Age 5 and Follow-up, and Observed Defiance at Age 5 with Number of Participants in Parentheses.

Factor	1	2	3	4	5	6
1. ECBQ Novelty Seeking Age 3	1.00 (103)					
2. CBQ Novelty Seeking Age 4	.38** (76)	1.00 (121)				
3. Preschool Novelty Seeking Mean	.85** (103)	.91** (121)	1.00 (148)			
4. CBCL Rule-Breaking Age 5	.07 (68)	.10 (97)	.11 (103)	1.00 (236)		
5. CBCL Rule-Breaking Follow-Up	.10 (35)	.12 (56)	.14 (58)	.50** (107)	1.00 (123)	
6. Observed Defiance Age 5	-.09 (45)	.13 (71)	.15 (73)	.12 (96)	.01 (59)	1.00 (99)

Note: One twin was randomly selected from each twin pair for these analyses.

** $p < 0.01$

Table 6

Paired Samples t-test Results for Novelty Seeking at Ages 3 and 4

Outcome	Time point 1		Time point 2		n	95% CI for Mean Difference		<i>t</i>	df	<i>p</i>	<i>d</i>
	M	SD	M	SD							
Novelty Seeking at ages 3 and 4	26.51	8.78	30.07	11.12	76	-6.13, -.99		-2.76	75	.007	-1.45

Table 7

Repeated Measured ANOVA for Rule-Breaking at Ages 5 and Follow-up

Effect		Value	F	Hypothesis df	Error df	Sig.
Rule-Breaking	Pillai's Trace	.00	.00	1.00	104.00	.955
	Wilk's Lambda	1.00	.00	1.00	104.00	.955
	Hotelling's Trace	.00	.00	1.00	104.00	.955
	Roy's Largest Root	.00	.00	1.00	104.00	.955
Rule-Breaking * Follow-Up Age	Pillai's Trace	.00	.17	1.00	104.00	.684
	Wilk's Lambda	1.00	.17	1.00	104.00	.684
	Hotelling's Trace	.00	.17	1.00	104.00	.684
	Roy's Largest Root	.00	.17	1.00	104.00	.684
Rule-Breaking * Sex	Pillai's Trace	.03	2.75	1.00	104.00	.100
	Wilk's Lambda	.97	2.75	1.00	104.00	.100
	Hotelling's Trace	.03	2.75	1.00	104.00	.100
	Roy's Largest Root	.03	2.75	1.00	104.00	.100

Table 8

Hypothesis 2: Heritability of Novelty Seeking at Ages 3 and 4, Rule-Breaking at Age 5 and Follow-Up, and Observed Defiance

Factors	MZ	DZ	h^2	z	p
	Correlation	Correlation			
ECBQ Novelty Seeking Age 3	.75	.08	.75	4.01	< .001
CBQ Novelty Seeking Age 4	.62	-.09	.62	3.99	< .001
CBCL Rule-Breaking Age 5	.81	.61	.40	2.95	.003
CBCL Rule-Breaking Follow-Up	.74	.40	.68	2.65	.008
Observed Defiance Age 5	.56	.19	.75	2.02	.043

Note: r_{MZ} was used to calculate heritability if h^2 calculation was greater than r_{MZ} .

Note: p value indicates significance coefficient between r_{MZ} and r_{DZ}

Table 9

Hypothesis 3: Mixed Model Multilevel Linear Regression Modeling Results, Showing Model Fits for Each Model Tested, with CBCL Rule-Breaking at Age 5 as the Dependent Variable, and Sex, Preschool Novelty Seeking Mean, Observed Defiance at Age 5, and the Interaction Between Novelty Seeking and Defiance as Independent Fixed Effects.

Model	χ^2 (df)	AICc	Vs. model	$\Delta \chi^2$ (df)	<i>p</i> value
1. Main fixed effect and random intercepts (baseline)	331.47 (5)	341.91			
2. Adding family effects as random effect	278.51 (6)	291.13	1	52.96 (1)	< .001
3. Model 2 plus random slopes	273.10 (8)	290.18	2	5.41 (2)	ns
4. Model 2 plus Novelty Seeking x Defiance interaction	278.02 (7)	292.86	2	0.49 (1)	ns

Note. AICc (Hurvich and Tsai 1989) = $AIC + [2k(k+1)/(n-k-1)]$, where *k* = number of estimated parameters and *n* = sample size. Model 2, bolded, is the best fitting model with a significantly better fitting chi-square than the other models.

Table 10

Hypothesis 3: Mixed Model Multilevel Linear Regression Modeling Parameter Estimates for Best Model (2), Predicting CBCL Rule-Breaking Age 5

	Estimate	95% CI	<i>p</i> value
Fixed effects			
Intercept	.88	.68, 1.08	.000
Sex	.18	-.05, .41	.117
Preschool Novelty Seeking Mean	-.00	-0.02, .01	.435
Observed Defiance Age 5	.11	-.29, .52	.582
Estimates of Covariance Parameters			
Within-family effect	.45	.30, .67	.000

Table 11

Hypothesis 3: Mixed Model Multilevel Linear Regression Modeling Results, Showing Model Fits for Each Model Tested, with CBCL Rule-Breaking Follow-Up as the Dependent Variable and Sex, Age at Follow-Up, Preschool Novelty Seeking Mean, Rule-Breaking at Age 5, Observed Defiance at Age 5, and the Interaction Between Novelty Seeking and Defiance as the Independent Fixed Effects.

Model	χ^2 (df)	AICc	Vs. model	$\Delta \chi^2$ (df)	<i>p</i> value
1. Main fixed effect and random intercepts	178.70 (7)	194.05			
2. Adding family effects as random effect	175.27 (8)	193.03	1	3.43 (1)	ns
3. Model 2 plus defiance as random slopes	175.05 (9)	195.28	2	0.22 (1)	ns
4. Model 2 plus Novelty Seeking x Defiance interaction	173.80 (9)	194.02	2	1.47 (1)	ns

Note. AICc (Hurvich and Tsai 1989) = AIC + [2 k (k+1)/ (n-k-1)], where k= number of estimated parameters and n= sample size. Model X, bolded, is the best fitting model with the lowest AICC value.

Table 12

Hypothesis 3: Mixed Model Multilevel Linear Regression Modeling Parameter

Estimates for Best Model (2), Predicting Follow-Up CBCL Rule-Breaking

	Estimate	95% CI	<i>p</i> value
Fixed effects			
Intercept	1.10	.02, 2.19	.045
Sex	-.01	-.31, .29	.942
Age at follow-up	-.00	-.16, .15	.974
Preschool Novelty Seeking Mean	.00	-.01, .02	.871
Observed Defiance Age 5	.58	.02, 1.14	.042
CBCL Rule-Breaking Age 5	.58	.38, .77	.000
Estimates of Covariance parameters			
Within-family effect	.17	.04, .36	.08

Table 13

Hypothesis 3: Correlations between CBCL rule-breaking items at age 5 and follow-up and preschool novelty seeking mean (ages 3 and 4 averaged)

		Preschool novelty seeking mean	Preschool novelty seeking mean correlated with
Item #		correlated with age 5	follow-up CBCL
		CBCL	
2.	Drinks alcohol ^a	-	.05
26.	Lacks guilt	.08	.02
28.	Breaks rules	.12	.14
39.	Bad friends	.07	.11
43.	Lies, cheats	.05	.17
63.	Prefers older kids	.10	.10
67.	Runs away	.12	.08
72.	Sets fires	.14*	.09
73.	Sex problems ^a	-	.14
81.	Steals at home	-.12	.12
82.	Steals outside home ^a	-.00	-.02
90.	Swearing	.05	.23*
96.	Thinks of sex too much ^a	.12	-
99.	Uses tobacco ^a	-	-
101.	Truant ^a	-	-

Table 13 continued

105.	Uses drugs ^a	-	-
106.	Vandalism	-.08	.18

^a Correlation could not be computed because the CBCL item had no variability.

* $p < .05$

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APPENDICES

APPENDIX A

INFORMATION SHEET

Date _____
 ID Number _____
 Age of Child/ren _____
 DOB of child/ren _____

Your Relationship to the child/ren (mother or father; please note if adoptive parent): _____
 Your Age: _____

Marital Status:

Single, never married _____ Married _____

Divorced/Separated _____ Widowed _____

Living with a significant other _____

Approximate Total Family Income:

____ less than \$5,000 ____ \$20,000 - 25,000 ____ \$40,000 - 45,000 ____ \$60,000 - 65,000 ____ \$80,000 - 85,000
 ____ \$5,000 - 10,000 ____ \$25,000 - 30,000 ____ \$45,000 - 50,000 ____ \$65,000 - 70,000 ____ \$85,000 - 90,000
 ____ \$10,000 - 15,000 ____ \$30,000 - 35,000 ____ \$50,000 - 55,000 ____ \$70,000 - 75,000 ____ over \$90,00
 ____ \$15,000 - 20,000 ____ \$35,000 - 40,000 ____ \$55,000 - 60,000 ____ \$75,000 - 80,000

Race of Child's Parents: Mother _____ Father _____

Race of Children in Study: _____

	Occupation (JOB TITLE)	Finished High School?	Attended College?	Years of College (undergraduate & graduate)	College Degrees (AA, BA, etc.)
Self		Yes No	Yes No		
Spouse or Partner if Living in Home with Children		Yes No	Yes No		

Please list the birthdates of all siblings of the children in this study, and please note if they are half-siblings, step-siblings, or adopted siblings of the children in this study:

Please list everyone living in your household and their relation (e.g., father, grandmother, etc.) to the children in the study. (First names only, example: Ben – grandfather)

We are interested in whether changes in the family, such as divorce or remarriage, affect children's behaviors. If applicable, please indicate if you have ever been divorced or remarried and the year this occurred.

Not applicable_____

Divorced _____

Remarried _____

Year_____

Year_____

Year_____

Year_____

APPENDIX B

Early Childhood Behavior Questionnaire (ECBQ) High-Intensity Pleasure Seeking Questions

Rated on a 6-point Likert-type scale

- | | |
|---------------------|------------------|
| 1. Almost never | 4. Usually does |
| 2. Rarely | 5. Frequently |
| 3. Usually does not | 6. Almost always |

High-Intensity Pleasure (12 items)

Pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novel, and incongruity

While playing outdoors, how often did your child

- 11. like making lots of noise?
- 13. want to climb to high places (for example, up a tree or on the jungle gym)?

While playing outdoors, how often did your child

- 44. choose to take chances for the fun and excitement of it?
- 45R*. not like going down high slides at the amusement park or playground

While playing indoors, how often did your child

- 74. like rough and rowdy games?
- 75. enjoy playing boisterous games like 'chase'?
- 76. enjoy vigorously jumping on the couch or bed?

While playing indoors, how often did your child

- 124R*. not care for rough and rowdy games
- 125. enjoy activities such as being spun, etc.?

While playing outdoors, how often did your child

- 190. want to jump from heights?
- 191. want to go down the slide in unusual ways (for example, head first)?
- 192. enjoy being pushed fast on a wheeled vehicle?

*R indicates the item is reverse-scored.

APPENDIX C

Children's Behavior Questionnaire Short Form- High-Intensity Pleasure Scale

Rated on a 6-point Likert-type scale

- | | |
|---------------------|------------------|
| 1. Almost never | 4. Usually does |
| 2. Rarely | 5. Frequently |
| 3. Usually does not | 6. Almost always |

High-Intensity Pleasure

Amount of pleasure or enjoyment related to situation involving high stimulus intensity, rate, complexity, novelty, and incongruity

- 4. Likes going down high slides or other adventurous activities.
- 10. Likes to play so wild and recklessly that s/he might get hurt.
- 33. Enjoys activities such as being chased, spun around by the arms, etc.
- 69. Likes to go high and fast when pushed on a swing.
- 78R*. Dislikes rough and rowdy games.
- 88. Enjoys riding a tricycle or bicycle fast and recklessly.

*R indicates the item is reverse-scored.

APPENDIX D

Child Behavior Checklist- Rule-Breaking Scale Items

Rated on a 3-point Likert-type scale

0= Not True (as far as you know)

1= Somewhat or sometimes true

2= Very True or Often True

Rule-breaking behavior

2. Drinks alcohol

26. Lacks guilt

28. Breaks rules

39. Bad friends

43. Lies, cheats

63. Prefers older kids

67. Runs away

72. Sets fires

73. Sex problems

81. Steals at home

82. Steals outside home

90. Swearing

96. Thinks of sex too much

99. Uses tobacco

101. Truant

105. Uses drugs

106. Vandalism

APPENDIX E

Parent-Child Interaction Coding Scheme v.17

Parent Ratings

If a single episode of the following measures -- Verbal Warmth, Verbal Negativity, Positive Physical, Negative Physical -- lasts more than 5 seconds, then a second episode should be counted; if there are 2 distinct behaviors or 2 unique verbalizations within that 5 seconds then 2 episodes should be counted. If a behavior is ongoing then every 5 second increment of that behavior should be counted as an instance. If there is a 2 second gap between episodes then 2 episodes should be counted.

-Verbal Warmth-

Verbal Warmth must be verbal in nature such as praise used in a verbal, non-physical manner, exaggerated affectionate verbal phrasing that stands out from the parents normal speech pattern such as talking in an pronounced happy or sing-song voice, such as positive, neutral or negative statements (a negative statement made in an exaggerated positive tone is considered verbally warm), or exaggerated affectionate tone used in conjunction with supportive, nurturing or comforting verbal behavior. Verbal warmth does not include simply affirming something was done correctly by the child.

1. Lots of verbal warmth used, 3+ instances
2. Some verbal warmth used, 2 instances
3. Little verbal warmth used, 1 instance
4. Parent shows no verbal warmth in language, neutral language with neutral tone may be present, 0 instances

-Verbal Negativity-

Verbal Negativity is harsh or unsupportive language used often, very critical language used (such as degrading remarks or mocking the child in a negative tone) the tone must be neutral or negative (if neutral tone is used the statement must be highly critical or negative to be considered verbal negativity) or harsh manner of conveyance used. Just saying "No" to a child is not verbally negative unless done in a harsh manner.

1. Lots of verbal negativity used, 3+ instances
2. Some verbal negativity used, 2 instances
3. Little verbal negativity used, 1 instance
4. Parent shows no verbal negativity in language, neutral language with neutral tone may be present, 0 instances

-Sensitivity-

*The parent's directing the child to the task does not affect sensitivity

1. Sensitive to child's requests or emotions, responsive to feelings and child's attempts to engage parent or evoke a response, attentive to child's mood in performing the task throughout the session, or if parent is primarily passive during the minute and allows the contented child to work without interruption. ***The mother should NOT be coded as a 1 if the child is doing nothing or trying to get the attention of the parent and is being ignored.
2. Some sensitivity and response to child's feelings, emotions, and attempts to engage parent or

evoke a response, some response and lack of response, or delay in response present towards child (the parent ignores the child part of the time and responds to the child part of the time), or the parent tries or makes the child do something they do not want to do.

3. Little sensitivity and little responsiveness to child, parent gives minimal support and responds rarely, irregularly, or sporadically, with moderate to large amount of lack of response to child, their emotions and behavior

4. Not sensitive or responsive at all to child, parent completely lacks response to child, parent fails to read child's cues and has little orientation to the child's needs, non-responsive to anything positive or negative that the child does

-Positive Physical-

Positive physical interaction characterized by hugging, holding, cradling, high-fiving, or wraps arms around child to help with task in a positive manner all in non-threatening interactions

1. Strong Positive, 3+ instances present

2. Positive physical interaction present, 2 instances

3. Some positive physical interaction present, 1 instance

4. Neutral physical interaction – interactions present such as handing the child objects and normal play but no positive physical interactions present, 0 instances

-Negative Physical-

Negative Physical interaction characterized by pulling, pushing, threatening gestures, rough moving of child (such as shoving or yanking on an arm in a negative manner), hitting, swatting, spanking, smacking, restraining the child without warmth or holding that hurts the child

1. Strong negative physical interaction 3+ instances

2. Negative physical interaction present, same criteria as above, 2 instances

3. Some negative physical interaction present, same criteria as above, 1 instance

4. Neutral physical interaction - interactions present such as handing the child objects and normal play but no negative physical interactions present, 0 instances

-Frustration-

Frustration should be in response to the child in the dyad being coded. Definite frustration present – raised voice, shortness with child, yelling, to the point of becoming open anger.

Frustration is constant throughout the minute or there is one very inappropriate instance present.

1. Definite frustration present – raised voice, shortness with child, yelling, to the point of becoming open anger. Frustration is constant throughout the minute or there is one very inappropriate instance present.

2. Some frustration present – raised voice or shortness with child, parent unable to handle task and child at the same time. Frustration is persistent or a few moderate instances present.

3. Little frustration present, one isolated instance of parental frustration such as raised voice, shortness with child or frustrated demeanor and tone.

4. No frustration or anger present towards child or task.

-Parent-Child Interaction-

Parent-Child Interaction is characterized by any interaction with the child. As long as the child is physically close and facing the parent and the task then the parent is considered to be

interacting with the child. If the parent and child are merely touching or sitting close, or the child is sitting on the parent's lap or leaning on the parent and they are not talking or working on the same task, then this should not be counted as interacting. If either the parent or child is trying to interact with each other than this time should be counted regardless of response or attention from the other party.

1. Parent interacts with child often either related to the task or independent of the task and is highly involved, 60-46 seconds of interaction between parent and child within a minute
2. Parent interacts with child some of the time, interacts with the child independently some of the time but ignores or is off task part of the time, 45-31 sec of interaction between parent & child within a minute
3. Parent interacts with the child little, some interaction present part of the time but the parent does not interact with the for a majority of the time child, 30-16 seconds of interaction between parent & child within a minute
4. Parent interacts very little with child, few isolated instances of interaction are present, parent is uninvolved with child for the majority of the time, 15-0 sec of interaction between parent & child within a minute

-Parent Discipline in Response to Problem with Child-

Use codes 1-3 for every instance of discipline during the minute in response to disruptive behavior. This includes interrupting the task such as walking or crawling away. If 2 discipline instances occur in a minute record both on the coding sheet under "problem discipline". If more than 2 discipline instances occur then record additional instances in the comments field of that minute and note what measure the codes correspond to. If a parent's type of discipline changes during a child's problem episode then code both types of discipline using an arrow between the two type codes. If the discipline style remains constant throughout the episode use only one code. For example, if a child leaves the task to bang on the wall and the parent ignores the child that minute would receive a "3". If a child leaves the task to bang on the wall and the parent first tries to reengage the child to the task, then ignores the child, that minute would receive a "1=>3". If the child gets up and bangs on the wall and the parent tries to reengage the child to the task, then later during that minute the child throws puzzle pieces and the parent ignores the child that minute would receive a "1", "3". Examples of problems are as follows; if the child is on task but not responding to the parent, if the child is passively watching their sibling. It is not considered a problem if the child is sitting passively in front of their own task or helping their sibling with the task. In certain circumstances these could be problems depending on the parent's behavior in the situation.

Use code 4 if no disrupting or interrupting behavior is present during the whole minute.

For 2-year-old-coding only: On task behavior is considered any organized behavior such as stacking, piling, or separating pieces. Also any play behavior that directly involves the pieces is considered on task such as use in playing or as jewelry. Incidental use such as kicking or throwing the pieces is NOT considered on task behavior. With this in mind, the parent's response to any behavior that is not on task should be coded using the below codes.

1. Parent exhibits Authoritative discipline; characterized by reasonably high demands for child compliance, coupled with emotional warmth
2. Parent exhibits Authoritarian discipline; characterized by punitive control methods and lacking emotional warmth
3. Parent exhibits Permissive discipline; parent does not exhibit discipline even though seems to

be needed as child is acting out or not cooperating to an extent that would disrupt the task or cause harm

4. Parent exhibits no instances of discipline as none are warranted

-Overall Parenting Style-

Code the parenting style used with the child predominately throughout the minute.

For 2-year-old coding only: If 10 seconds pass without the parent directing the child to the task and the majority of the minute the parent does not direct the child to the task, then code for permissive parenting style (3). Otherwise the parent should be coded as authoritative or authoritarian.

1. Parent exhibits Authoritative style; Parent directs child to task with emotional warmth and reasonably high demands for child compliance in task
2. Parent exhibits Authoritarian style; Parent directs child to task in a controlling or punitive manner with no emotional warmth
3. Parent exhibits Permissive style; Parent exhibits Permissive style; Parent does not direct child to task, or if parent does without high demands and the child does not comply, parents lets it go (doesn't push the issue)

-Affect-

For affect, you may see positive affect and negative affect both in a single minute, positive affect and no negative affect (neutral) in a single minute or negative affect and no positive affect (neutral) in a single minute. Affect should only be coded in response to the child in the dyad being coded. Behaviors as well as verbalizations should be included in rating of affect. For example, smiling, laughing, cheering, and high-fives should all be counted as positive affect.

-Positive Affect-

Code what best describes the **average** positive affect across the minute. For example, if the child is neutral for 55 seconds of the interaction and shows a few isolated signs for 5 seconds the minute should be coded as a 4.

1. Parent is very happy and energetic, is gleeful, exuberantly happy, or very bouncy for most of the minute
2. Parent is happy and seems to be in a positive, content mood fairly continuous throughout the minute, the parent exhibits smiling or talking in a positive tone
3. Parent is slightly happy, shows a few strong isolated signs of being happy or positive but mood is subdued. For example a genuine positive tone that is not merely talking in 'motherese', exclamations of happiness or warmth, or smiling with a low energy level
4. Parent is in a neutral or negative mood, almost no signs of a happy or positive mood are present, characterized by little or no positive facial expression

-Negative Affect-

Code what best describes the **average** negative affect across the minute. If there is no negative affect code 4- neutral or positive mood. For example, if the parent is neutral for 55 seconds of the interaction and shows a few isolated signs for 5 seconds the minute should be coded as a 4.

1. Parent is very unhappy, upset, sad, or negative in mood
2. Parent is sad, upset, or unhappy in mood fairly continuously throughout the minute

- or a number of strong negative instances are present
- 3. Parent is slightly unhappy, sad, upset, or negative in mood, shows a few isolated signs of being unhappy such as frowning or dampened tone
- 4. Parent is in a neutral mood or positive mood, almost no signs of an unhappy or negative mood are present, characterized by little or no negative facial expression

Child Ratings

If a single episode of the following measures: physical aggression, verbal negativity, physical affection, lasts more than 5 seconds then a second episode should be counted, if there are 2 distinct behaviors within that 5 seconds then 2 episodes should be counted. If a behavior is ongoing then every 5 second increment of that behavior should be counted as an instance. If there is a 2 second gap between episodes then 2 episodes should be counted.

-Aggression Level-

Child pushes, hits, kicks, throws objects, pulls, hits, grabs or takes toys in an aggressive manner, purposeful resistance, aggressive disruption of other child's task, or lots of aggression towards parent or child.

Also, verbal aggression such as insulting, harsh or mean language directed at the sibling or parent, name-calling, yelling at, relational aggression, threats made to parent or sibling, or yelling to get the parent's attention that is not gleeful

1. Very Aggressive, 3+ more instances
2. Moderate amount of aggressiveness, same criteria as above, 2 instances
3. Some aggression or aggressive activity, same criteria as above, 1 instance
4. Not aggressive at all, very mild demeanor and no physical aggression towards other child or parent

-Aggression Type-

Classify instances as Reactive Aggression (RA) or Proactive Aggression (PA).

RA=Reactive aggression: Code RA if the child behaves aggressively in response to something the other child or parent has done. For example, if the sibling or parent says something that makes the child unhappy and the child responds by getting angry or being physically or verbally negative to the other child, code RA.

PA=Proactive aggression: Code PA if the child behaves aggressively without first being provoked by the other child or parent. For instance, if the child begins to hit his/her sibling without the other child doing or saying anything to provoke it, then code PA. This includes all proactive physical or verbal aggression that is not a reaction to something the other child said or did.

*** In some instances both RA and PA can occur during one minute. If this happens, code them in the order that they occur in the minute. For example: If a child first shows reactive aggression and then shows proactive aggression, it would be coded as RA/PA on the coding sheet.

-Physical Affection-

Child is very loving and engaging towards parent or sibling, shows affection, hugs or kisses, helps in tasks such as sharing, or leans against the parent

1. Very affectionate, 3+ instances
2. Some affection, 2 instances

Little affection, 1 instance Indifferent to parent or sibling, or no affectionate interactions or helping behavior present

-Responsiveness to Parent-

Responsiveness should be coded in response to anything the parent does.

1. Very responsive to parent, cooperates with parent well, very interested and engrossed in parent's directions
2. Moderately responsive to parent, cooperates at times with some distraction but participates, tries to follow parent's directions
3. Little responsiveness to parent, little cooperation present and appears distracted most of the time
4. Not responsive or cooperative to parent at all, plays on own and/or actively ignores, resists or disobeys parent
 - 9. Parent does not attempt to engage child at all, therefore no responsiveness can be captured. If the parent engages the child for even 5 seconds of the minute, do NOT code as -9

-Cooperation with Sibling-

1. Very cooperative when together with sibling, shares toys and works with sibling in a harmonious nature or if the child works independent of the sibling on the same task/puzzle for the majority of time together
2. Moderately cooperative when together with sibling, cooperates, shares, or works together with sibling
3. Little cooperation when together with sibling, little sharing and cooperation or some disruption of the siblings task
4. Not cooperative when together with sibling, does not share, work with sibling, or cooperate at all during task or disrupts other child's task while working on the same task, toy, puzzle
- 9. Child does not work on the same task, toy, or puzzle as sibling

-Task Orientation-

Task orientation is the active time spent working on or interested in the task. This is regardless of whether they are working with a parent or sibling but merely the amount of active time they spend on the task. This does not include throwing puzzle pieces, interrupting the sibling's task for disruptive purposes, passively watching their sibling, or playing with the puzzle pieces or board in a non-task oriented manner.

For 1-year-olds: include any interaction with puzzle pieces such as chewing, holding, carrying or throwing pieces but not holding the bag the puzzle comes in.

For 2-year-old-coding only: On task behavior is considered any organized behavior such as stacking, piling, or separating pieces. Also any play behavior that directly involves the pieces is considered on task such as use in playing or as jewelry. Incidental use such as kicking or throwing the pieces is NOT considered on task behavior.

1. Lots of time spent on task, 60-46 seconds
2. Some time spent on task, 45-31 seconds
3. Little time spent on task, 30-16 seconds
4. Very little time spent on task, 15-0 seconds

-Affect-

For affect, you may see positive affect and negative affect both in a single minute, positive affect and no negative affect (neutral) in a single minute or negative affect and no positive affect (neutral) in a single minute. Behaviors as well as verbalizations should be included in rating of affect. For example, smiling, laughing, cheering, high-fives, dancing, skipping, somersaulting, or other jubilant behaviors should all be counted as positive affect.

-Positive Affect-

Code what best describes the **average** positive affect across the minute. If there is no positive affect code 4- neutral or negative mood. For example, if the child is neutral for 55 seconds of the interaction and shows a few isolated signs for 5 seconds the minute should be coded as a 4.

1. Child is very happy and energetic, visibly happy and bouncy, almost the whole minute
2. Child is happy, in a positive mood and smiling or amused fairly continuously throughout the minute, talks in a positive tone or smiles often
3. Child is mildly happy, occasionally smiles or talks in a positive tone, or a few strong isolated signs of happiness such as exclamations, outbursts of joy, beaming smiles or laughter
4. Child is in a neutral mood or negative mood as no positive affect is present almost no signs of a happy or positive mood are present, characterized by little or no positive facial expression

-Negative Affect-

Code what best describes the **average** negative affect across the minute. If there is no negative affect code 4- neutral or positive mood. For example, if the child is neutral for 55 seconds of the interaction and shows a few isolated signs for 5 seconds the minute should be coded as a 4.

1. Child is very upset, throwing a fit, crying, screaming, yelling in a negative manner, almost the whole minute
2. Child is upset, crying and whining a lot or withdrawn behavior present fairly continuous throughout the minute
3. Child is slightly upset, frowning, whining or withdrawn behavior is present
4. Child is in a neutral or positive mood as no negative affect is present, almost no signs of an unhappy or negative mood are present, characterized by little or no negative facial expression

General Task Ratings

-Task Length Completion-

If task ends early, note exact time and child/children/parent responsible for early task ending

1. Full task time is completed (10 minutes)
2. Task ended early (Note Time and Child/Children/parent) – Due to parent's or children's lack of continued interest, resistance to task, or finishing of task
3. Task ended early (Note Time and Child/Children) – Due to children's affect/disposition, fussy and tired in general, not task specific

APPENDIX F

Twin 1 id _____
Twin 2 id _____
Age _____

Zygoty Form Rater

Family # _____ Sex _____ Test date/Time _____
Rater _____

Tester diagnosis: 1 2
 MZ DZ

Rater confusion: 1 2 3
 None/rare Yes/lots Some/at first

	Very similar			Not at all	
	1	2	3	4	5
Facial appearance	1	2	3	4	5
Eye color	1	2	3	4	5
Complexion	1	2	3	4	5
Hair appearance	1	2	3	4	5
Hair color	1	2	3	4	5
Hair texture	1	2	3	4	5
Hair curliness	1	2	3	4	5
Hair pattern	1	2	3	4	5
Amount of hair	1	2	3	4	5
Ear appearance	1	2	3	4	5

ID # _____ ID # _____

Hair color: Blonde Red Brown Black	Blonde Red Brown Black
Hair darkness: Light Medium Dark	Light Medium Dark
Hair texture: Coarse Medium Fine	Coarse Medium Fine
Amt of Hair: Lots Some Little	Lots Some Little
Hair type: Curly Wavy Straight	Curly Wavy Straight
Eye color: Blue Hazel Brown Green	Blue Hazel Brown Green

ID _____
 Age _____
 Date _____

DOB _____

IDENTICAL OR FRATERNAL?
Parent Form

Please circle the appropriate response:
 Rater: Mother or Father

<u>APPEARANCE</u>	Very Similar			Not at all similar	
Facial appearance	1	2	3	4	5
Eye color	1	2	3	4	5
Complexion	1	2	3	4	5
Hair appearance	1	2	3	4	5
Hair color	1	2	3	4	5
Hair texture	1	2	3	4	5
Hair curliness	1	2	3	4	5
Hair pattern	1	2	3	4	5
Amount of hair	1	2	3	4	5

“MISTAKEN IDENTITY”

Do people know which twin is which, when the twins are together and when they are apart?

	Frequently confused			Never confused	
Mother: apart	1	2	3	4	5
together	1	2	3	4	5
Father: apart	1	2	3	4	5
together	1	2	3	4	5
Friends & relatives:					
apart	1	2	3	4	5
together	1	2	3	4	5

MEDICAL

Has your obstetrician or pediatrician indicated an opinion on whether the twins are identical or fraternal?

If so, what is the diagnosis and what is it based on?

Is there a history of twinning in your family? If so, please describe.

APPENDIX G

PROPOSED RECRUITMENT E-MAIL FOR PREVIOUS SITSS FAMILIES

Dear Parent,

First of all, thank you for having participated in the Southern Illinois Twins/Triplets and Siblings Study (SITSS) in the past. I am a graduate student in clinical child psychology program at Southern Illinois University Carbondale and work with Dr. Lisabeth F. DiLalla at SITSS. For my thesis I am hoping to expand upon the current SITSS sample to include follow-up data for children between ages 6-16. This study will involve having you complete **a single questionnaire** for each of your children (the Child Behavior Checklist). We are interested in your children's behavior and interaction with others.

We would love to have your help in this study! If you are willing to participate or are interested in getting more information about this study, please **respond to this e-mail saying you are interested** and send us your current postal mail address. When I receive the information from you, I will mail you a formal consent form and questionnaire for you to sign, fill out, and return.

To thank you for taking the time to be in this study, I will be offering a lottery ticket for a raffle to win a small prize for each family who participates in the study.

All information that we receive from your children will be held as strictly confidential. All questionnaires and data will be identified only by an identification number that is assigned to your children. Your children's names will never be placed on the questionnaires or on any data that we receive. Your name, address, and phone number will be maintained in a confidential file in order to contact you. All information will be kept in a locked file cabinet and only trained researchers on this project will have access to that file.

We do not anticipate any risks to you and/or your children while participating in this study. A slight risk to you/your children is the improper release of you/your children's private information. The chance of this happening is very small. We have protections in place to lessen this risk.

If you have any concerns or any questions, please feel free to contact me (phone: 618-453-5206; email: ediaz@siu.edu).

This project has been reviewed and approved by the Springfield Committee for Research Involving Human Subjects at Southern Illinois University School of Medicine, 801 North Rutledge, Springfield, IL 62702, Telephone number: (217) 545-7602.

I hope that you will join us in this exciting endeavor! I look forward to hearing from you. If you have any questions or concerns, feel free to email me at ediaz@siu.edu.

Sincerely,
Emma Diaz, B.A.

Graduate Student
Clinical Child Psychology, SIUC
Ediaz@siu.edu

APPENDIX H

PROPOSED CONSENT FORM FOR FOLLOW-UP STUDY- AGES 6-16

This research project is a study of the way that children and adolescents behave and interact with others. The purpose is to better understand how children develop socially and to identify how early temperamental characteristics may affect behavior later in life.

You will be asked to complete one questionnaire in order to provide us with information that will help us to learn more about your children's behavior and social environment. Please fill out one questionnaire for each child. Do one questionnaire, and then do the other questionnaire separately. After you have finished, return the questionnaires and this form in the enclosed self-addressed, pre-stamped envelop.

We do not foresee any risks involved with this project. A slight risk to you/your children is the improper release of you/your children's private information. The chance of this happening is very small. We have protections in place to lessen this risk. After the questionnaire is completed, you will be entered into a lottery to win a small prize to thank you for your participation.

Only myself, Dr. DiLalla, and her assistants will ever see the questionnaires. All the questionnaires will be identified only by an identification number that is assigned to your child. Your child's name will never be placed on the questionnaires or any coded data. Your name, address, and phone number will be maintained indefinitely in a confidential file in order to contact you in the future for other related research. All information is strictly confidential and will never be shared with anyone outside of this laboratory. It will be kept in a locked file and on password-protected computers in the lab and only Dr. DiLalla or a trained research assistant will have access to that file.

Under Illinois law, an exception to confidentiality is incidents of child abuse or neglect. If, in the course of this research, we develop reasonable cause to believe such an incident has occurred, we are required to contact the Department of Children and Family Services (DCFS).

If you have any further questions about this research project, please feel free to contact me, Emma Diaz, at (618) 453-5206, or ediaz@siu.edu.

If you agree to participate in this project and to have your child participate, please fill out the section(s) below:

I have read the material above, and any questions I asked have been answered to my satisfaction. I understand I will receive a copy of this form for the relevant information and phone numbers. I agree to participate in this activity and realize that I may withdraw without prejudice at any time.

Parent's Signature _____

Date _____

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone: (618) 453-4533. Email: siuhsc@siu.edu.

VITA

Graduate School
Southern Illinois University

Emma Diaz

Diaz.emma90@gmail.com

University of Nevada, Las Vegas
Bachelor of Arts, Psychology, May 2013

Special Honors and Awards:

Society for Research in Child Development Millenium Scholar

Thesis Title:

The Assessment and Etiology of Novelty Seeking and Rule-Breaking in Young Children

Major Professor: Dr. Lisabeth DiLalla

Publications:

DiLalla, L.F., McCrary, M., & Diaz, E. (in press, 2017). A review of endophenotypes in schizophrenia and autism: The next phase for understanding genetic etiologies. *American Journal of Medical Genetics Part C*.